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PUFFINS

By the same author

SHEARWATERS

THE WAY TO AN ISLAND

LETTERS FROM SKOKHOLM

I KNOW AN ISLAND *(Harrap)*

EARLY MORNING ISLAND *(Harrap)*

ETC.

The sociable puffins
by C. F. Tunnicliffe

PUFFINS

by

R. M. LOCKLEY

Illustrated with
a coloured frontispiece by
C. F. TUNNICLIFFE
drawings in the text by
NANCY CATFORD
and
16 pages of photographs,
and maps

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FOR MARTIN

The Puzzled Naturalist and the Puffin

The P.N.: Puffin! Puffin! thou dost go
Through wild western gales that blow;
Tell me, what discreet decree
Prescrib'd thy strange pomposity?

Why this fashion, thus to flight—
Bill roug'd—dressed in black and white?
What, as well, dost thou suppose,
Is signified by outsiz'd nose?

Puffin, puffin, answer me,
Why thy clown's formality?
What attraction, what affair
Ordains such dress, so debonair?

The Pn.: Him who made me thus so free,
Winged to fly through air and sea,
On (and under) earth to go,
Ask Him your riddles: He will know.

Complemental verses found in a puffin-watching hide. (*With apologies to William Blake.*)

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PREFACE

THIS book began long before 1953. Yet twenty years of intermittent observation of the puffin have only proved to me how little we know about one of the commonest sea-birds of the North Atlantic; it has successfully kept most of its domestic affairs under the ground and so hidden from us. I had meant to devote so much more time to this study. But now my apology for presenting this unfinished story to the reader must be that this little knowledge, although a dangerous thing, ought to be aired so that it may serve to encourage others to continue by first-hand observation the narrative of the life-history of this enchanting bird.

I would acknowledge my debt in preparing this volume to a number of writers for such information as I have borrowed from their books and papers, a list of which is given at the end of this book. To my wife and to my brother-in-law John Buxton, and to Rosemary Russell, I am grateful for reading the manuscript and suggesting improvements which have been incorporated; to James Fisher for detailed notes on the distribution of the puffin; to Skokholm Bird Observatory for recent notes; to E. P. Leach for access to the ringing records at the British Museum of Natural History; to the several friends for supplying me with the photographs acknowledged under each illustration; and to my friends Stephen Marchant (the owner) and Charles Tunnicliffe (the artist), for permission to reproduce the beautiful painting as a frontispiece.

R. M. L.

CHAPTER I

THE MIND OF A BIRD

He hath made everything beautiful in his time. *Ecclesiastes.*

HANDSOME he certainly is, and shrewd-looking, as he stands there, staring at the advance of the wire rod. But his behaviour suggests that he is not particularly intelligent by human standards. Otherwise he would show greater alarm; he would not peck inquisitively, idly, at the hooked tip of the rod as it is pushed close to his legs. Even when the hook is slipped over the flat scaly keel of his foot he is not greatly perturbed; he side-steps neatly, and once more pecks at the wire.

There is now only a distance of twelve feet between the hand of the human being and the bird. The nine-foot-long bamboo rod with its three feet of wire bridges the gap. So long as you crawl over the ground gently and push the rod very slowly, inch by inch, you can get very close to the puffins. And it needs very little practice before you acquire the art of hooking and holding them. The people of St Kilda used such a rod, which ended in a hair-and-quill noose, and caught hundreds per man per day.

You may decide from his behaviour that the puffin is stupid. And looking at him closely you begin to see that the bird really resembles a clown. Apparently he is not only mentally stupid but he actually dresses like a clown, even to the false eyebrows, cheek smears, and big, red, false-looking nose! Surely he must be abysmally dull-witted to permit himself to be captured by so simple and obvious a contrivance?

There he stands, now glancing at the rod, now jerking his head to gaze towards the azure sea, or upwards at the singing lark or passing gull, and now towards his companions of the green cliff slopes. A strange, and perhaps to the unreflecting passer-by, a booby, an ignoramus of a bird. But before we pass a final judgment are we not ourselves ignorant of the working of a puffin's mind? It is a natural habit of man to judge birds anthropomorphically, a habit not altogether to be condemned perhaps. After all we live, and therefore must assess, by human standards.

But what standards does a puffin live and assess by? What were the thoughts of our puffin *about us*, as with jerking head he kept himself informed of our unusual movements in the familiar world about him?

A book about one bird ought perhaps to begin with a few observations on the mental capacity of its subject? But it cannot be a very lucid dissertation—we know so very little about the mind, it is not 'observable,' only the actions or responses to given situations are observable. We might begin by declaring the obvious: that the puffin sees us clearly, as we see him. He watches us as we watch him; he follows our movements with the appearance of intelligence. But it is a puffin's intelligence—and that is almost as far as we can go. It is important for us to remember that to the puffin the man with the bamboo rod is not really a familiar part of his environment. If it were possible for us to see with the eyes and to think with the brain of the puffin we might understand better why the spectacle of a human being, crawling on all fours and pushing a rod towards him, caused curiosity rather than alarm. It would not be surprising if the puffin found the sight as amusing and as clownish as we had found him! As it is, however, we can only imagine his line of reasoning—it he possesses such a faculty. We must remember that the puffin's experience of man is limited. At sea, where most of a puffin's life is spent, he never, or very rarely, encounters man, singly as an individual or as an enemy, except in the form contained in ships and fishing-boats. On land the puffin, nesting on remote cliffs and islands, sees man irregularly, and usually at too great a distance to cause him any interest or anxiety.

The puffin is accustomed to the quiet movements of other large creatures—sheep, rabbits, gulls, and other birds—in or near its nesting burrows. So long as these movements remain gentle the puffin does not take alarm. Even its formidable enemy the great black-backed gull may walk about in a puffinry without alarming more than those puffins which are within three or four feet of the gull. They are, however, watchful as the gull draws closer, and seem to observe carefully the 'mood' of the predator as shown by its attitudes; and sometimes the great gull seems deliberately to assume an attitude of innocent exploration with the object of disarming the victim, or the gull may remain still for so long that the puffins seem to forget its presence. Then, as swiftly as the watching, motionless cat pounces on the mouse, the gull strikes the nearest puffin and kills it. So too does man become habituated to the presence, watchful of the behaviour, but sometimes forgetful, of the dangerous internal combustion engine in the streets where every day this formidable enemy regularly kills a certain number of the unwary among the human population.

Many birds, and especially the social sea-birds, seem to have little or no inborn fear of man. The puffin appears to tolerate man on a basis of indifference, so long as man's movements are quiet when he makes a near approach to the puffinry; and this attitude is often modified from one of indifference to interest because of the puffin's intense natural curiosity which, like that of ducks at a decoy which will follow a ferret or a dog into the dangers of a wire-netting pipe trap, will even compel it to walk closer to a *strange*, quietly moving object. But this curiosity can wear out and, after being hunted frequently with the long rod for ringing purposes, puffins show a definite shyness of the instrument —those ringed, and those which were hooked but escaped before ringing, have *learned* the danger or unpleasantness of being handled or hooked, and they take off before the hook reaches them, thus spreading alarm through the assembly. However, after a few days this lesson often seems to have been forgotten, and the skilful, patient observer may catch again with the hook the puffin which he ringed a few weeks before—although not with the same ease with which he may catch the unringed puffin; a certain shyness lingers during the rest of that summer—as I found when studying ringed individuals at the nest. In the great puffinries in Iceland and the Faroes, where the same cliff sites have been used for untold generations by the sea-bird catchers, the puffins never seem to become wary of these danger points; but this is explicable: the art of the wildfowler with his long-handled net is both lethal

and is practised only for a very limited period in the summer. He takes, and kills, the only individuals which could have carried the warning to the puffinry; his business is soon over, and those favourite flighting places are once more safe, for another year, for *the thousands of puffins that use them.*

On the other hand the danger from gulls and other avian predators is always present, even in the winter at sea, and so it has become part of the puffin's instinct to be watchful of gull moods. Instinctive behaviour is inborn, and is the first safeguard; but intelligence, if only of a specialized and limited kind, is also part of the puffin's equipment, and as we have seen, and we shall see again in this book, the puffin is capable of learning, by experience, to adapt its behaviour to avoid dangers and unfavourable situations; and so to enjoy life as fully as any bird that has ever been studied. He is not so much a clockwork toy of actions and reactions after all. He is not altogether a soulless machine, automatically responding to sign stimuli or signals. His mind is not a blank screen. He is capable of enjoying life. As a subject for study the puffin, in fact, gives the observer an added pleasure from this appearance of enjoying life to the full in the crowded puffinry, where his qualities of neighbourliness, affection, faithfulness, curiosity, idleness, etc., as this book will relate, prove to be so nearly human.

I had thought I might be able to describe more fully the mentality of the puffin, but I find that I know so little that it would be hazardous to expose this ignorance by further theoretical discussion. I might have found out more concerning its learning ability from a study of the puffin in captivity; but this book is concerned only with its natural life in the open. I have never kept puffins in captivity for longer than a few hours; except once, for a day, in carrying out a homing experiment. I have watched the behaviour of a puffin released in the island house at Skokholm, where its actions were partly intelligent but largely instinctive. It pattered around the room, with its characteristic walk, investigating beneath the furniture and poking into corners, as if seeking an outlet. In this way it behaved much as we may imagine primitive man would behave if by some mischance he awoke and found himself in a natural chamber he had never visited before, say beneath the boulders of the cliffs—a situation which we have chosen because it is comparable to that in which a puffin might occasionally find itself by accident or exploration. Man, finding himself imprisoned in a dark unknown place, would instinctively hunt for a way out, and being sure-footed would do so energetically, going towards the light or the draught of air, and using his intelligence in making minor decisions as to the best route to escape from an unfavourable situation. The puffin in the room behaved in the same way, but was of course handicapped by two things: an intelligence inferior to that of man, and the inability to fly in so confined a space. It was interesting to note that, provided the human observer kept absolutely still, the puffin continued energetically to explore every part of the foot of the walls enclosing the room, paying particular attention to the door, the draught of wind under which probably informed it (albeit instinctively) of a way to the open air. When the observer in turn walked noisily about the room the puffin retired beneath the linen chest, where it was in semi-darkness and out of our sight. How much of this behaviour was instinct and how much intelligence? To survive for a while in life a bird must have both. When we remained still once more the puffin emerged, a little cautiously, and resumed its pattering exploration. Periodically it rested, as if it was undecided as to what to do, or was tired; until at last the experiment was concluded by taking the bird out of doors, ringing it, and flinging it into the sky. It rose up into the wind, and swept down towards the cliffs; it was back on the assembly ground (where it had been hooked in the first place) when we passed that way on the following day.

The other experiment was a test of the inborn intelligence or instinct known to be possessed by many birds in homing. Six puffins were captured and ringed at Skokholm, and transported and released at Start Point, Devon, on 18th June, a distance of 225 miles from Skokholm by sea around the Land's End, or 130 miles direct overland. Two of these puffins were recaptured five days later; probably all returned sooner or later but, although these experiments proved that puffins, as might be expected of a pelagic species, have a good (but, almost certainly, instinctive) sense of geographical position, puffins were not used again because of the difficulty of retrapping these birds near or in their burrows—shearwaters proved to be more ideal subjects.

* * * * *

Let us return to the bamboo rod; the hook is now firmly around the leg of our victim. We pull the rod gently but steadily towards us, hand over hand. The fluttering and growling of the captured one disturbs only a few of the hundreds of puffins assembled on the grassy slope about us. Those near us fly away towards the sea; but the majority take little or no notice, and continue with their idle sunning, visiting, and normal social affairs.

Often before, at a safe distance, they have seen *one* of their colony suddenly killed by a great gull and nothing has hurt *them*. They have borne as charmed a life as the men who see their fellow men run over in the streets. Sudden death is the familiar of life, especially in the wild, and the disappearance or murder of one individual in a large colony from time to time is of no great consequence to any of the survivors except the bereaved family. Indeed in a populous colony of sea-birds (or men) any nesting site vacated as a result of the death of one or of a pair is an opportunity for the rest which is quickly seized by homeless adults.

Ah! We have captured our bird! Warily we close our right hand over the back of the puffin, our first and second fingers sliding each side of the black nape of the neck and firmly holding the great beak from turning to bite our hand. Our palm and thumb and littlest fingers enclose his wings. We lift him clear from the rod. He struggles strongly, kicking the air with his webbed feet, which are armed with sharp little claws that will easily draw blood from a tender skin. We see that the majority of puffins have not moved and, as we examine our capture, those which did fly away are already circling overhead and dropping to earth one by one in a wide circle about us. When one of a herd of cattle is attacked the rest will come to its defence; if a flock of sheep is set on by a dog, the individuals will bunch together and run in unison; but the puffin, like so many sea-birds, shows only a little interest in what we are doing to the individual. One or two birds ran forward at the first agitated flapping of the victim, as if they sensed that a fight was taking place (always of interest to bystanders), then were alarmed and flew a short distance. St Kildans used to kill one puffin after another, quietly breaking their necks, while the assembly from which they drew each capture remained almost undisturbed.

* * * * *

So this is *Fratercula arctica grabae*!

D. R. Wood

She, too, was ringed

Now we can examine a creature which to me, accustomed to it by long study, appears beautiful, but to the majority is more odd than handsome. We shall try to describe him in non-scientific language.

First, his head is as large as a golf-ball, on which is clapped a parrot-like coloured beak, the most arresting feature of this astonishing bird. This bill or beak extends from the forehead like an enormous keeled Roman or false nose. It is curved to a blunt point like the lower portion of the human heart. The extremity of the upper bill is slightly hooked, and the tip of the lower mandible closes under this hooked point. The distal or terminal portion of this great structure is painted a bright wagon-red, with two or three distinct ridges following the sickle curve. The rest of the bill is smoke or lead grey, edged with a rim of pale gold, almost ivory. A very fine line of crimson is the dividing mark between feathers and bill, expanding at the mouth into a fleshy rosette, a wrinkled jowl of vivid orange. The nostril is a slit one-third of an inch long, and one millimetre wide; it lies close to the inner, biting edge of the upper mandible. So we may speak of the beak as a nose without straying far from the truth, for the nose is part of the beak.

The eye is no less remarkable. It is placed well forward, giving almost binocular vision. Barely one-quarter of an inch in diameter, it has a black pupil and a grey iris faintly suffused with brown and dotted with very fine dark specks. The white of the eye is dull; fine blood-vessels give it a reddish cast. The lids form a perfect circle of wagon-red about the open eye. There is a fleshy grey triangular plate above, and a rectangular one of the same colour and leathery texture below; it is these beauty-parlour adornments (they are assumed for the duration of the breeding season only) which enhance the clown-like appearance of the face.

The feet are vermilion, fading to deep orange-red, and eventually lemon, as the colours, with the summer months, wear out. The three toes are joined by strong webs with sharp horn-coloured claws on each foot extending well beyond the webs; but the outermost claw projects hardly at all. There is no hind toe.

The plumage is a neat arrangement of black and white. The face is not pure white—it darkens to grey near the neck and beneath the bill; and the undersides of the wings are smudged with grey-white. The breast, belly, and under tail are pure white.

The rest is black—the crown of the head, the back, and the outer surface of the wings and tail. The black of the head takes the form of a monkish cap, usually divided from the black of the back by a thin white line, particularly noticeable in the females. The black of the back extends to form a narrow collar around the neck. The whole has been aptly likened to the appearance of a prosperous, bibulous, old man in dinner suit; complete with black jacket, white shirt-front, black bow tie, and rubicund nose.

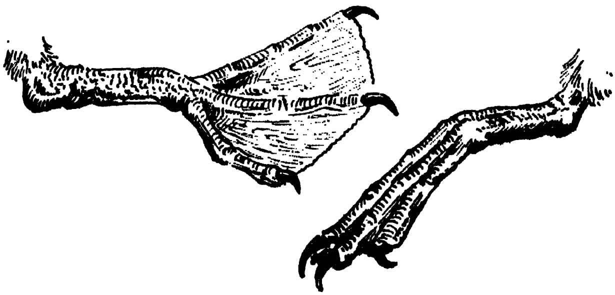
It has been convenient to use the masculine tense in describing our capture, but as a matter of fact he proved to be male. He and his wife were the individuals around which part of the observation in this book was recorded. He was only one among one hundred thousand puffins on the island of Skomer, South Wales, in the summer of 1946. Having caught him I placed a numbered ring on his right leg. He was noticeably larger than his wife, whose facial adornments were less ostentatious. To be exact I found that his yellow orange lips or jowls (rictal rosette is the anatomical term) were three millimetres wider than his wife's, and the black cap on his crown was four millimetres broader. His tail, however, was slightly more faded, or browner, than hers. His beak was bigger, and piped with three full ridges—sign of his maturity.

His wife was caught and a ring placed on her left leg. But in addition she had the outer web of her left foot torn, an old, healed wound by which she could be distinguished without the aid of the ring. Her beak had two distinct ridges almost parallel to the outer edge.

* * * * *

He has struggled long enough. In spite of our precautionary hold, he has managed to twist his head and deliver a wrenching bite with the sharp nippers of his bill. Having drawn our blood in this way he has scratched our hands, as we clipped on the ring, with those excessively sharp claws which—we are no longer surprised to learn—acting together with the bill as pickaxe, enable him to excavate a burrow in the hard earth, even at times and by degrees, in soft rock.

He has deserved his freedom and we let him go, watching his plump body whirring down from the cliffs to the white-speckled blue waves upon those stumpy, rapidly fluttering (rather than wildly beating) wings. As if upset by our treatment of him he flies onwards and seawards, ignoring the raft of fellow puffins which lies on the surface of the water a few yards from the tide-washed boulders below. He has gone a long way into the ocean. In spite of those absurd penguin-like wings he may travel many miles, many leagues. . . .



CHAPTER II

THE WINTER OCEAN

> Surely they speak a language whisperingly,
> Too fine for us to hear; and sure their ways
> Prove they have kings and laws, and that they be
> Deformèd remnants of the Fairy-days.
>
> JOHN CLARE.

FAR OUT over the grey-blue waters of the North Atlantic, across three thousand miles of the Gulf Stream, the puffins have wintered, enduring the long fugues of the westerly gales under skies now black with storm and now clear and blue between scattered white clouds. Sometimes the dull grey monochrome of the easterly breezes covered sea and sky. Probably existence was hardest during the mighty cyclones of midwinter, for the puffin is no great aviator, and a continuous gale from one direction might force it far to leeward of its normal feeding-grounds. But if so it seldom seemed in danger of being driven ashore, apart from an occasional sick bird or one which had become fouled with waste oil thrown into the sea from the bilges of tankers. These casualties are from time to time wrecked on West European coasts and reported by shore-watchers and beachcombers. But they tell us little about the oceanic wanderings of the puffin.

A light breeze is of assistance to the puffin, lifting and sustaining its wings. But a strong gale estimated at 60 miles an hour checked puffins in flight over Skokholm Island, so that they made no more than three or four miles an hour ground speed. In the open sea when the wind reached 55 knots, measured by anemometer, puffins were estimated to be moving forward into the wind at only 8–10 knots; but when the wind velocity reached 80 knots no puffins were seen to leave the water. H. R. H. Vaughan measured the flight speed of puffins from a ship undergoing speed trials in the Clyde, and found that they moved at about 50 land miles per hour through the air. It is therefore safer in a hurricane for the puffin to remain swimming on the surface, and to escape an approaching ship or other obstacle not by flight, but by diving. Its small wings are almost as well adapted for swimming under water as for

R. P. Bagnall-Oakeley

Himself and Herself

aerial swimming; in fact in the denser medium it is far more manœuvrable. The wings are not fully extended under water; the primaries are closed like the leaves of a fan, thus strengthening and making paddles of them.

Like an old-fashioned sailing ship the puffin avoids a lee shore and keeps well at sea in the stormy period of the year. Observers have seldom recorded it in winter within sight of land, between the end of October and the beginning of March, except in the sheltered Mediterranean seas. It has been seen in mid North Atlantic in December, from which month onwards to March there is a concentration on the famous fishing-banks south of Newfoundland. As the puffin breeds in the New World, although in small numbers, it is possible that these mid and west Atlantic records were of puffins native to Maine, Canada, and Greenland. But our European puffin has been proved beyond doubt to cross the Atlantic: two individuals ringed in August as nestlings at St Kilda, Scotland, have reached Newfoundland in December of the same year. Probably these birds crossed direct, without touching or being in sight of other lands—for it was a long journey (of 2,500 miles) for juvenile birds to accomplish in a short time.

Dispersed over the North Atlantic and western Mediterranean in winter, swimming on or under the water in bad weather, the puffin during those inclement months is almost unobserved by man. We are entitled, however, to surmise that life in the open sea is as normal and as easy as it has ever been for this ancient species. For millions of years it has so wintered, and its oceanic life cannot be more dangerous than that of other pelagic sea-birds. It may be even more successful than some; thus, as one pair of puffins produce only one egg each year, and one pair of gulls (which we normally regard as strong tough birds) two or three, it would

appear, at a casual estimation, that the average expectation of life of the puffin is longer than that of the gull.

We know so little of the winter life of the puffin, however, although it is necessary for us to try to sketch it here as an introduction to the narrative of the events of summer. No observer has found the puffin in dense flocks in winter. It is evidently widely distributed, even to some extent, solitary, in midwinter. This spacing out, of course, is an advantage biologically: there is a greater area available for food; it is harder for the enemies of the puffin to find it; and locally severe storms can affect only a small proportion of such a widely scattered species.

We do know, nevertheless, that soon after the departure from the islands and cliffs where they bred, and probably not more than a week or two after the arrival in deep water, the adults experienced a strange although natural transformation. We might call it a de-beautifying. They lost the bright adornments of the spring. The colours of these had slowly faded day by day in summer. But now the rainbow-coloured bill was partly sloughed off, the astonishing emarginated ivory rim or scroll separating the face from the upper mandible disappeared, and the lower half of the lower mandible looked as if it had been slashed away with a sharp knife. In fact the bill had lost its shape and was decidedly ugly; its comic but colourful appearance had changed to a stage of undress, as if the clown had stuck half-way in the act of taking off his false nose. The wagon-red eye-rims and the grey panels above and below the eye had disappeared, as well as the fleshy rosettes of the mouth. This process is part of the annual moult which takes place in two periods: the whole of the body plumage is moulted in the autumn, but excepting the wing- and tail-feathers. These quills are needed to carry the puffin far away from the land; they are retained until late in winter.

Soon after the New Year the puffin, safe in winter quarters, completes the moult at sea, shedding almost simultaneously the primary and secondary wing-feathers and the large feathers of the tail. It is even probable that, like geese and rails, it may become flightless for a very short time during this moult. At the same time the whole of the body plumage is once again renewed. The fleshy and horny adornments, which correspond to the comb and wattle of the domestic hen and turkey, are gradually resumed. They develop as the outward sign of the swelling of the gonads and internal sexual apparatus. With the return of the sun, with the longer hours of daylight upon the cool waters of the northern ocean, these gay decorations increase in size and depth of colour, until by the middle of March they are at their finest. Newly made up, and in newest dress, the adults are quite resplendent as they make their spring landfall, on their return to the sounds and islands where they are familiar to us.

* * * * *

No man has yet written of the courtship of the puffin far at sea, beyond sight of land. Probably no courtship takes place there. Let us, however, imagine that ocean gatherings take place in early March, within a few hundreds, even a few score, miles of land; these assemblies have at least been observed near the Newfoundland Banks and in the western Mediterranean. Let us imagine the shoreward concentration of individuals returning on brand-new wings from the deep ocean, the joining up with others to make those characteristic line-ahead, line-abreast, square, and triangular formations in the air; the gradual, steady approach to the land, the frequent settling on the water to rest and feed, and perhaps also—stimulated by the landfall—to flirt and play.

No signal has been given, except that of the internal rhythm or physiological clock which informs every bird of the time of day, and month, with the regularity of the most perfect time-keeping piece made by man. No visible message has been flying from the general headquarters of the winter puffinries, yet without fail they advance on the land at the immemorial day and hour. No royal decree of a Puffin Grand Council has gone forth, although older naturalists were inclined to give credence to the idea that such gregarious birds must be ruled by a prince or king who issued some telepathic communication directing the seasonal movements.

A prince of puffins? Is this a romantic piece of folklore, suitable for the fairy-tales? Are puffins 'deformèd remnants of the Fairy-days,' with 'kings and laws'? As far as we know it is simply a figure of the imagination. But we must be careful not to be too scornful; folklore often has a basis in fact. In the Faroe Islands the bird-fowler, who may kill more than a hundred puffins in a day, will tell you that his trade does no harm to the puffin chick in the burrow, since for every young puffin there are seven adults, each prepared to act as foster-parent. The fowler thus excuses himself for taking the adults in the breeding-season. Now it is a fact that seven puffins (or six, or five, or four, or three) may enter a burrow together; I have seen such an event not infrequently, and have put it down to social visiting and idle curiosity or simply to the fact that there must be more than one nest in the same burrow. But, although it has been proved that penguins and guillemots will sometimes adopt an orphaned egg or chick, or steal or pirate one in the temporary absence of the real parents, I have never discovered puffins doing so.

To return to the first point: scientific regard for the truth compels me to admit my ignorance on this question of what, other than inherited instinct and the seasonal physiological changes, guides the annual migrations of the puffins. New facts are coming to the light to help us, especially as a result of ringing these birds; yet each discovery brings with it more fascinating speculation. Need we therefore apologize to the reader for occasionally applying human criteria and imagination to the problems contained in this book? The more we study the higher forms of warm-blooded creatures the more human they reveal themselves to be, and therefore the less we find ourselves accepting them, fashionable as it may be among research workers to-day, as automatons. We need to remember that humans though we be, many of our reactions are animal and instinctive. Perhaps if we gave the animal the benefit of the doubt occasionally and permitted it a little simple reasoning we should understand its ways more easily?

* * * * *

Early in March, the mad month of the mainland hares, the month of daffodils in western shires and singing birds in leafless copses, the doe rabbit is already suckling her first family in some 'stop' or cul-de-sac in the catacombs of the puffin burrows, whose entrances are becoming green with the glaucous curtains of the sea-campion, the scurvy-grass, and the atriplex. Here and there, in wet north-facing cliff-niches, the primroses glow with a waxen light, sheltered from the prevailing wind.

Well may the rabbits of the puffin-haunted islands hurry these early *accouchements*. There is need for haste. Far out over the vast plain of the sea there is a new movement, a convergence towards the shore. The long sojourn there has re-equipped the pelagic nomads with the ardour necessary for a successful breeding season. Their plumage is perfect again: the black frock-coat of the puffin has a deeper hue, with the suggestion of gloss, and the shirt-front is as if starched whiter than the snowy manes of the storm-waves. The guillemot and razorbill have both put on black bonnets and scarves. The gulls have shed the grey shawls of winter in favour of gleaming white head-dresses—while the blood-red spot (mark of a carnivorous life) on the lower mandible has deepened to scarlet.

Hasten then, young hapless conies, to scatter to new nurseries before those powerful bills arrive on the islands, the puffin's to drive you forth, the gull's to stab you to death. Be warned from the joyous songs of the rock-pipits which soar singing over the underground tenements that spring is well advanced!

CHAPTER III

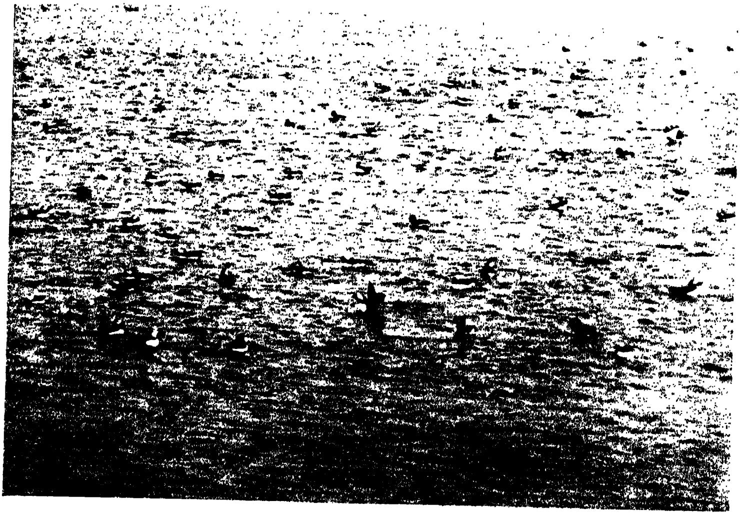
RAFTS INSHORE

My belovèd spake, and said unto me,
Rise up, my love, my fair one, and come away.
For, lo, the winter is past,
The rain is over and gone;
The flowers appear on the earth;
The time of the singing of birds is come.

The Song of Solomon.

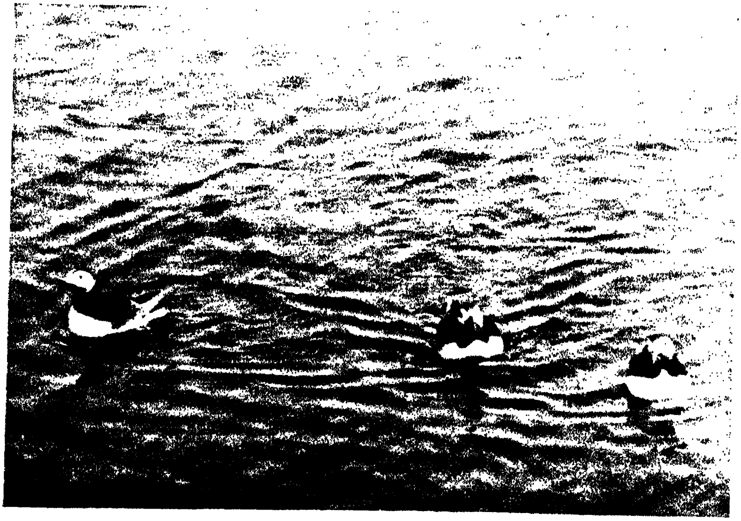
ALTHOUGH no prince of puffins has issued the order for the assembly at the breeding-grounds, there comes a day, late in March, when the numerous tribe instantly appears, as though by such a royal decree. It is as if some general knowledge of the assembly day had gone abroad on the wind over the waters, and at this mysterious signal the whole colony has turned up suddenly on the sea close under the cliffs. The lobster fishermen of the west coast, who place their pots along the rocky shore under the puffinries, like to make a little drama of it, and will insist that, at the command of their leader or king, the puffins appear *hey presto*, then vanish with equal simultaneity. They remember how their fathers placed trammel-nets along the cliff edge as soon as the puffins arrived, for the birds were both good to eat and a favourite bait for shellfish, before the puffins were protected by new laws. They regard the puffin with affection, perhaps a little covetously still; at sight of the amusing birds they take heart to set their pots closer inshore, believing that spring has really come.

But is it true that the puffins arrive in a great army, as the fishermen—not always very close observers—state? Not exactly. Invariably one or two days before the main party appeared, I (eagerly watching every bird when I lived for twelve years on Skokholm) would notice that a few puffins were swimming or flying near the shore, like pilots surveying the land for an advancing navy. One could imagine that these were the spies who would report back to the fleet at sea and give the order to converge on the islands. 'The harbours are free—sail in!' But is the puffin capable of delivering such a message to the seaward



R. M. Lockley

The first rafts gather on the sea under the cliffs



R. M. Lockley

Male bodyguard

host? Since we learn that the tiny worker bee, with its minute brain, can advertise to its fellow workers of the hive that it has found new sources of honey by performing a special kind of dance, may not messengers also exist in puffin communities?

For the moment the more simple explanation seems to be that these few early puffins are not messengers but just older birds, probably males, which, familiar with the breeding-ground over several seasons, and now sexually well developed, are anxious to mate and set up housekeeping. They are the vanguard of the fleets, made up of individuals all with the same urge in varying degree, which we presume to be lying at ease in extended formation offshore.

If only we could discover the whereabouts of those offshore fleets, and quietly watch behaviour in the ranks! What is happening there? Are they setting to partners, and pairing for the season, out of sight of land? Let us recapitulate.

From its more solitary state during the autumnal moult and the winter solstice, and following the early spring shedding of the flight and body feathers at sea, the puffin has gradually become more gregarious. In its new plumage it steers a course for the land. In March the dumpy black-and-white forms are seen swimming in the clear water of the sounds and channels within sight of land, singly, or in small chevrons, or flying perfectly straight, unwavering as the bee. At this stage of their first approach to the land, I did not see a pair together more often than a trio, a quartet, or a greater number. It looked as if the puffin had not found a mate at sea. But if it had done so, when and where did this happen? If it happened why should odd birds (males?) come quizzing towards the land in advance of the main fleet? Perhaps puffins remain paired throughout the year? Perhaps the puffin is faithful to its mate 'as long as both shall live'?

Evidence of fidelity, or otherwise, during the winter is wanting—chiefly for lack of observation. But how, we may ask, could one puffin easily remain in close contact with another during the blinding storms of winter when wind and wave must inevitably separate them, and there is no stable thing to form a rendezvous? Surely the tricks of weather and water must drive them apart until they are lost to each other amid the scattered tribes of their companions?

Yet sea-birds do have a rendezvous in the larger sense that they migrate to, and remain for long periods within, definable stretches of the ocean, especially on fishing-banks, as at Rockall and the Newfoundland Banks. An experienced mariner without the aid of instruments knows by colour, current, and other signs far at sea when he is at fishing-banks familiar to him. Obviously sea-birds, with better instinctive knowledge and a better bird's-eye view, recognize such places.

Therefore a meeting-place at sea is not impossible, though storms may temporarily separate the lovers. It should be remembered, however, that at the end of the breeding-season the successful adult ought to be worn out and no longer interested sexually in its mate. For some time before abandoning the land the male and the female have worked at the task of feeding the chick quite independently of each other. Having accustomed themselves to fish separately at sea is it likely that they would consciously seek each other in order to perform the seaward winter migration together, side by side?

Is it not more likely that the puffin does not, except purely by accident, meet its mate of the summer at sea, out of the breeding-season? Even if this accident occurred would recognition of each other take place?

We are asking questions which are hard to answer. We should reflect that a great change in their facial appearance takes place soon after the adults leave the nesting burrows, and this may make recognition by sight after an interval at sea alone very difficult between mates. This is important, since the puffin is an almost silent bird, vocally and instrumentally, and must therefore depend largely on sight recognition for identifying individuals at sea.

Perhaps after all then it is the cock puffin which arrives first at the breeding-cliffs? In the majority of birds the cock (whose hormonic development is in advance of the hen's) precedes the hen, selecting a suitable nesting (or pre-nesting) site and advertising it by demonstration (posturing and displaying of fine plumage) and singing, calling or croaking, according to the splendour of his plumage and the powers of his larynx. A few days later the hen puts in an appearance, and as soon as she is physically ready to breed she agrees with the male. If both are familiar with the old nest-site the old cock will accept the hen which he mated with last season the more easily, probably at once.

If the cock is a new bird and has settled on the site of an old nest he may have to fight for possession with last year's owner, and he may well lose the battle by virtue of the old cock's just determination to drive away the interloper. The moral and territorial advantages are with the old cock; the young cock by comparison is nervous and unfamiliar with the environment. But should he by physical prowess win the fight, or otherwise secure the territory, he may still have difficulty with the old hen. To him she is a stranger, and he may treat her as a rival for the ground he occupies. If she resembles him closely in plumage, he may not be able at once to know her sex. Thus, for example, the male black-headed gull's first reaction to an approaching female is hostile; she too displays at him—the performance is mutual, and until the female shows signs of submission, indicating an urgent sexual interest in the male, he remains aggressive at her approach. The same is true of many species where the sexes are alike: the robin is a familiar example.

This behaviour is more advantageous than it might seem at first glance: the possession of territory suitable for nesting is almost a guarantee of securing a partner. (A bachelor with a desirable house soon finds himself courted by spinsters and widows.) But until that partner has proved herself a desirable mate (that is, sexually potent) it would be a risk to admit her to share the premises. There are exceptions to this rule, however.

In some species where the sexes are unalike, and the cock (in the phalarope, the hen) is more magnificently coloured, sex recognition at sight must be easier; and in fact of these birds the displaying male in possession of a territory does not usually drive away the dull-coloured female, but accepts her immediately—if she is willing. Again, the gorgeous ruff, like the antlered stag, uses his adornments chiefly to intimidate a rival, by which means he secures as many wives as he can. His demonstration takes place, not at the nesting site but on a special jousting or tournament arena, and is entirely one-sided: the female takes no part except to submit to the male most successful in these mock battles. Thus the threat display of birds is utilized in various ways. The rule appears to be: mutual display in species where the sexes are alike in plumage, and where monogamy is practised; one-sided display in those birds where the male is more highly coloured—and especially where the most brilliantly adorned males, displaying in groups to each other before the dull females, are polygamous.

* * * * *

The fleet is in! The flotillas of the puffins have anchored in the bays and creeks of the islands. As if a toy armada of painted ships had suddenly and simultaneously come up from the sea-bed, we find them one morning, a day or two after the first scouts were seen, carpeting the quiet water at the base of their breeding cliffs.

Make haste to observe them; for from our experience of many years' study we know that to-morrow there may not be a puffin within sight of the islands. But it turns out that on this first day very little activity is observed. The puffins have appeared all at once, at about nine in the morning, in thousands. Their arrival had been unostentatious, an impression heightened by their silence. So idle are they, floating gently, hardly swimming at all, that one wonders if they are not perhaps tired, as if from a long journey? They sleep much, bill tucked back into the feathers at the base of the wing. Now and then one bird swims tentatively towards another or follows, or appears to follow, and guard a mate. They meet, rub bills together as if in greeting, then drift apart. There is a constant glancing towards the land, as if the puffins were anxious to go ashore; but this may be pure imagination on our part—a puffin never ceases when awake to swing its head in a half-circle, to and fro, a jerk at a time.

But no, the risk of going ashore is not taken on this first day. After two or three hours of inspecting the land, the sky, the water, and each other, the puffins suddenly depart without touching the land, moving away as quietly as they appeared, and vanish completely from the neighbourhood of the islands.

Let us take a random sample from the arrival records at Skokholm. In 1949 the first puffins, two, were seen offshore on 23rd March. On 25th March six were seen. On 26th March about five hundred appeared. None was seen then until 30th March, when it was estimated that one thousand were gathered on the water. This behaviour is typical of all the springtimes I have watched this bird: scouts first, a few days before the first large contingent arrives. And usually a fine calm day for the main fleet, fortunately for the observer, whose delight is the greater for the peace of a sunlit day in which to lie on the rocks and watch from the sea's edge.

Perhaps the simultaneous appearance and disappearance and reappearance of the flotillas should not be made too much of a mystery? The reader may justifiably ask: 'Why shouldn't the urge to return on some lovely day in spring occur simultaneously to each individual puffin making up the hundreds or thousands of a given colony, just as thousands of human beings put on their summer clothes and flock to the country or to the sea on the first warm week-end in spring?' The scientist would prefer to explain the movement in terms of the effect of increasing sunlight (ultra-violet light) on the glandular and hormonic activity of the body; although even the scientists change or vary their theories, and recently it has been suggested that the bird, because it keeps its seasonal movements so accurately to the day and hour, may be less influenced by weather phenomena than by its own internal rhythm or 'clock,' which, provided it is wound up regularly with the right fuel (food), determines its periods of growth, adolescence, breeding, moult, and migration. The internal rhythm of man carries him through childhood to maturity, marriage, and parenthood over as long a period of years as that of the puffin does of months; although because of the artificiality of modern life man's seasons have tended to become individually irregular; but the life-stages of primitive men, such as Eskimo and the aborigine, are as regular as the clock.

So then we are all, modern and primitive, man and puffin, subject to instinctive impulses. We all have uncontrollable automatic reactions; and the layman is perhaps not altogether wrong in attributing to the puffin this human joy and simultaneous desire to return on this fine (instead of a poor and stormy) day in spring to the scene of last year's tryst with his mate. We may deny that the brain of the bird is capable of philosophic thought, and thus it is inferior we say to that of man, but we ought not to claim the monopoly of the aesthetic-sensual pleasures of perceiving and taking advantage of and enjoying fine weather. The brain of the bird is capable of navigating a migration which no man, without mechanical aids, could undertake; a feat which, it has recently been proved, requires of the bird a considerable appreciation of sun, wind, haze, calm, even perhaps of the moon and stars, and certainly an acute time-sense.

Many colonial nesting birds perform these sudden descents upon the nesting ground. Guillemots return most suddenly of all, arriving in thousands at precipitous cliffs where they remain an hour or two on a fine morning in December, January, and February. They disappear with the same suddenness and completeness. As, however, they live closer to the shore all through the year, these assemblies are easier to explain. Gannets return in February, but do not form great rafts on the sea under the isolated stacks and cliffs where they breed; they fly round and round early on those first mornings, and soon settle down to the old nesting sites, which one or other of the mated pair will not leave again until the end of the breeding-season seven months later. In the open congested gannetry it is essential for the owners of a nest to mount constant guard to protect the egg or chick from predatory gulls, and to defend the nest from the beaks of thieving neighbours which are ever ready to grab the bulky nest material and add it to their own homes.

The puffin, nesting underground, has not the same problems as the surface nesters. The guillemot and the gannet are typical of sea-birds which lay their eggs under the open sky, and which mate at the nest-site within the limited area claimed and defended as territory (first established probably by the male). The gannet actually mates in the nest, since it has not an inch of territory outside the rim of the pedestal on which the egg is deposited; for the low ground, one yard wide, which separates one nest from the next is neither neutral nor safe—it is a dangerous no man's land within the range of the stabbing bills of jealous neighbours. What then of the puffin pair, which have the blessing of a quiet

home to themselves at the end of a dark burrow? Do they enjoy there, discreetly underground, a connubial bliss unobserved by curious spectators?

But no! In spite of this safe harbourage or lovers' retreat, in spite of the splendid opportunity of this obliterative screen, the puffin conducts his courtship in the full blaze of the publicity of the social mob. The act of union takes place in the open, and on the sea.

If the puffin mates in the darkness of the burrow it has not been recorded—and of course it would not be easy to witness. It might be a physically difficult act in the smaller burrows with low ceilings. We have, however, found the Manx shearwater mating in its burrow, which is of the same size as that of the puffin, but usually this and other shearwaters mount and tread in the open, near to the mouth of the burrow. No one has observed the shearwater mating at sea; but in the height of the mating season I have often sailed through its great evening assemblies, a mile or two from its breeding-islands, and found each individual quiescent on the water, usually quite silent, well spaced apart from its neighbour, and no amorous behaviour going on. Only when it is quite dark on spring nights will the shearwaters rise from the sea and with passionate cries descend on the islands, each mated bird calling and seeking its partner in or near the familiar burrow. Evidently for the shearwater mating is an inconvenient business at sea, and the stimulus of territory on land is a prerequisite for successful coition. No matter if it is pitch-dark, the shearwater pair keep in touch by voice recognition.

The opposite serves for our puffin. It begins to be clear to us that the early arrival and rafting under the cliffs at the end of March has a special significance as a preliminary to the mating ceremonies. These are diurnal, and take place only on the sea. This device is time-saving, particularly in the high Arctic where the rock-burrows are choked with snow late in the spring.

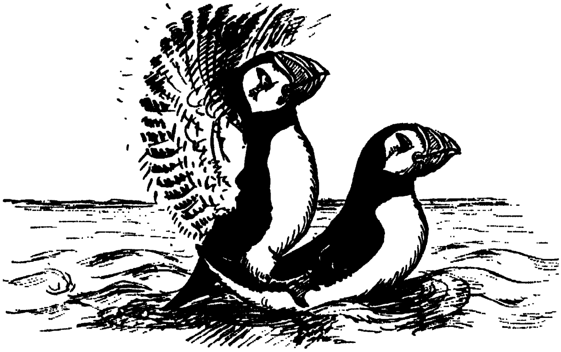
On the first day of the larger assembly, as we have recorded, in the last days of March or even the first day of April, nothing very exciting happens: as if tired the puffins doze, gaze at the cliffs, swim to and fro within a small compass, and then soon depart. There is little bill-rubbing, which is to say that there is little love-making.

Is this because the majority are males? Perhaps this is as good an explanation as any at the moment. Certainly each bird is well spaced apart on the water, as if wary of, or sexually disinterested in, its neighbour. Unmated wild birds establish what has been called 'individual distance' round them, which they like to keep clear of strangers. Man instinctively does the same, except when compelled to herd with others in a crowded room or vehicle. The distance is usually one body-length of the bird apart (in man it is about the length of the body, too). If this individual ring-fence is invaded by a stranger, one or other or both move at least one body-length apart; usually the newcomer is warned off by the stationary bird, which makes a threatening gesture or call. The puffin on the sea treats his neighbour in this way. That is, until he is mated, when he establishes a new individual area, which might be called a 'husband and wife territory,' or more scientifically 'mated female distance,' around the lady of his choice. The invisible ring-fence is now around the pair; he swims touching her at times, and guards her, and drives away rival males and would-be seducers that cross the unseen but well-defined barrier. But sometimes he finds that he and his *inamorata* are, by a trick of a wave or the wind, hemmed in by hundreds of neighbours, and he cannot maintain the correct 'mated female distance.' Not only for them, but also for all, this is an intolerable situation; sociable as puffins are, they cannot bear overcrowding. When this happens the alarmed company dives, and disperses under water. Thus, too, the 'water-dances' of the razorbills and the guillemots are broken up when the company runs the risk of collision and too great an intimacy as a result of their excited display, which may continue in the form of an underwater chase. The male puffin, however, I never saw in pursuit of the female under the clear water.

How human this is. In a raft of puffins the pair stands out from the closer-woven pattern of unattached birds because the jealous male now requires a much greater distance than one body-length between the chosen female and the crowd, which he drives away when they press too near. Of course it is not easy to observe whether the guarded lady is really his wife; she may only be a female which he happens at that moment to be making love to, or perhaps endeavouring to appropriate against her inclinations.

Each day of the assembly, as the raft swells with new hundreds returning from the infinite ocean, the number of mated females, each billed and guarded and pursued by a male and swimming apart with him, increases.

From time to time these paired birds perform the ritual of consummation. The male swims after the female, and when she is ready she allows him to overtake her. He flutters on to her back, and, without touching or holding her nape (as is the practice in most species of birds), he maintains his position by rapidly vibrating his wings. His small tail is twisted sideways around hers, which is elevated to make the way clear. He appears always in danger of toppling backwards, for his weight, so far back on her stern, tilts her breast into the air. It does not look very comfortable, this joining of male with female puffin. It lasts perhaps for five or six seconds of ecstatic contact. Mating is repeated, but not excessively. It ceases as soon as the egg is laid.



CHAPTER IV

FLIRTAGE NAUTIQUE

> In a kingdom by the sea . . .
> A maiden there lived . . . with no other thought
> Than to love and be loved by me.
>
> POE.

THE LAST chapter has raised a crop of new queries which it would take years of patient observation to answer satisfactorily. For instance it may be asked, if the male puffin does not remain attached to his mate of last summer throughout the winter, does he find her at once in the assembly raft? And if so, how does he recognize her and she him? To the human observer all puffins look alike and, unless seen close to, the big-headed males are indistinguishable from the slightly smaller females.

We had better watch through the binoculars the behaviour of one mated pair on the water, and single out the activities of the male in particular. We consult our note-book—under the heading 'Skomer, 16th April 1946,' is the following:

He is a stout fellow, with large bill and as fine a white shirt-front as any in sight, and he is swimming quietly behind another which we presume to be his mate. One is again struck by his droll appearance—he is exactly like a mechanical duck with a parrot's head, a toy that has been wound up and must perform certain antics as long as the tension of the interior spring remains.

As he swims over the gleaming surface she retreats. He pursues. She suddenly turns and meets him. They rub bills. She moves away, and he follows. She is keeping roughly to the same few square yards of the sea, close to the main raft, as if anxious not to be cut off from the crowd—an impulse which may be due to the puffin's strong sociability. In her circling she avoids other puffins, keeping her own 'individual distance,' but the male is ready, close behind her, to enforce 'mated female distance' rules upon unwary trespassers or rivals.

As he follows he jerks his head vertically upwards with the regularity of the mechanical clockwork toy which he resembles. I cannot hear his call, but I know that this head-jerking may be accompanied by a very faint, almost imperceptible, porcine grunt; this might not be heard by the female above the other, louder noises of the sea on the rocks and the ceaseless calls of the gulls. But she can see plainly that stiff and, to the observer, amusingly human method of advertising his desire, which suggests that he is bidding her to him.

'Come!' he seems to be signalling. 'Come! I'm tired of following you round, my dear . . .'

Alas for the dangers of anthropomorphic imagination. I soon discover that the female is also jerking her head upwards in the same way, and at the same speed—about once every other second—as if she were mocking him: 'What of it? Why should I come at your beck and call?'

The significance of this head-jerking becomes obscure once more. If both sexes do it then obviously the ceremony must be classed among similar mutual displays in birds which are stimulating and infectious, such as the greeting ceremonies of grebes, the bowing and calling salutes of the gulls, and the curtsying obeisance of the gannet.

His steady chase of his lady over the surface of the water, and her retreat, bring them within the thickest part of the main raft. It seems to me that this is now dangerously congested by the action of this pair; for others give way before them, and some appear to follow them out of curiosity. Thus a ring forms around them, of spectators jostling each other willy-nilly and turning their heads this way and that. Suddenly the pressure is relieved by the simultaneous diving of the whole ring of watchers. There is space for the chase to continue. But now comes forward a bird which, from his behaviour, must be male. This big-headed individual surreptitiously joins the first male in the quiet pursuit of the little-headed hen. The competition is endured for a distance of perhaps three yards before the first male turns upon the intruding wooer with swift wrath. Hitherto he has moved by swimming with his broad vermilion paddles, when following his lady. Now anger and jealousy propel him towards his rival with flailing wings and lunging beak. The interloper, as if aware that he had behaved indecently, makes off at an equal speed, whereupon his pursuer desists, and turns back towards his female. She had paused as if to watch the incident, with feminine curiosity perhaps, remaining at three or four body-lengths' distance.

Now, when he swims towards her, she makes no attempt to reward him by a nose-rub of approval. She deliberately turns away and coquettishly retreats; but in no panic.

Is there something specially enticing now in the presentation of her black back to his gaze? Perhaps her emotion has also been heightened by his triumph over his rival? At any rate he suddenly leaps towards her and overtakes her. In a second he has alighted on her back, a feat which nevertheless could not have been accomplished without her submission.

She allows him to remain there, well down on her stern, for the time necessary to complete the mating.

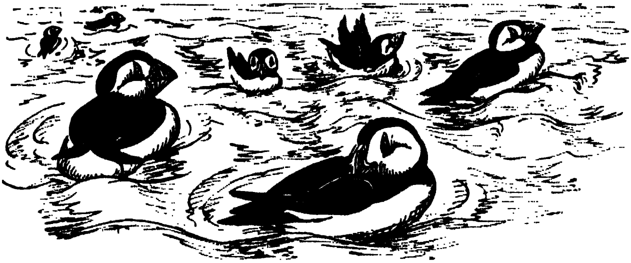
Head-jerking, followed by mating, is typical of the ceremonies which go on throughout April; and always coition takes place on the surface of the water, never successfully on the land. From watching the water-matings we confirm our opinion that there would hardly be room inside the burrow for the male to mount the female in this fashion. Without sufficient head-room he would find it difficult to settle back over her stern, as the moment of consummation seems to require.

Temporarily satisfied the pair fall apart, and each begins to preen vigorously, as birds so often do after mating, which disarranges the plumage. The oil gland at the base of the tail is tweaked with the point of the bill, and the back of the head rubbed over the exuding grease; using the head as a kind of oily mop, the bird busily waterproofs the whole of its plumage in several minutes of steady application.

Meanwhile the rival male (we believed it was the same bird) has come forward again; he was deeply interested in the mating, but was hesitant to interfere. The incident had evidently had a stimulating effect on him because he now makes a little rush at the preening female, who is quite neglected by her satisfied partner drifting at some distance and engrossed in his toilet. She swims away, alarmed, and endeavours to resume her oiling operation at a safe distance. But the rival charges her again, and would have leaped on to her back if she had not escaped by diving.

She swims under water for such a distance that it is impossible to follow her and detect where she surfaces, somewhere in the dappled pattern of the puffin raft.

The satisfied male continues to preen, as if oblivious of the attempted seduction; and next lies half over on his side, exposing that part of his white breast to the sun. After oiling his underparts, he rests, half careened towards the sun, basking at ease in the assembly. He is so idle that we can give our full attention to the rival male, who is now swimming through the raft as if seeking another adventure.



Had he been human he might have been accused of promiscuity. He seemed abundantly charged with energy and determined on a conquest. I do not know whether the female he now selected was the one who had lately escaped him by diving. She might have been his true mate, so persistently did he follow her. Perhaps, after all, the other male had been the seducer? How may we tell individuals at sea unless we brand them with distinctive marks?

He pursued this female through the raft, twice pausing to drive away other puffins, presumably males, which sought to join in his *flirtage nautique*. But as long as I watched him he had no success. Eventually she, too, disappeared by diving. He did not attempt to follow her under water; and finally I lost him in the throng.

The reader must interpret this promiscuity, if such it was, as best he may. It was puzzling to me at first. But what follows in this book may or may not suggest why the French give to the puffin the alternative name of *mormon*, which in French means 'latter-day saint,' or alternatively 'member of a religious sect which practises polygamy.'

CHAPTER V

THE FIRST LANDINGS

> O dream of joy! is this indeed
> The lighthouse top I see?
> Is this the hill? is this the kirk?
> Is this mine own countree?
>
> *The Rime of the Ancient Mariner.*

To RETURN to our pair caught with the bamboo rod in the colony of 100,000 puffins at Skomer Island in 1946. There he is, with the ring on his right leg; and there she is, with the ring on her left leg which also has the split web. They are our marked birds, mated, and sharing one and the same burrow.

We have something solid in the form of individuals to observe at last. We shall describe the events of their days on land, throwing in the weight of our observations from twenty other summers of our acquaintance with *Fratercula arctica grabae*, whose breeding biology I had first described in a scientific journal as long ago as 1934.

Frater will perhaps be a suitable name to give to the male of this pair, to avoid confusing repetition of the third person pronoun in this book; and *Cula* shall serve as a feminine name for his wife. Although both wore rings the continual repetition of their identity numbers, AC1942 and AC1943, would be tedious and perhaps an affront to the literary susceptibilities of the reader.

Let us begin then by clearing the character of Frater. Several times I attempted to follow the behaviour at sea of both Frater and his wife when on the rare occasions I could watch them fly down from their burrow to the water together. Like any other scandalmonger I was alert for the possible misbehaviour of Frater, having, as related in the last chapter, already noted the promiscuity, or at least rakish behaviour, of certain males in the rafts below the high cliffs. The chief difficulty, of course, was to hold one pair in sight continually in the glittering mosaic of black-and-white dots patterning the silver and blue of the bay.

On the only (two) occasions early in May when I was able to watch with binoculars their behaviour on the sea for a while, Frater swam close to Cula, driving away other puffins which invaded the magic circle of mated female distance which he had drawn about his spouse. But he did not pay any amorous attention to other females. Frater was faithful to Cula, even on the sea where, in her absence on duty at the burrow, I never saw him molest a strange female.

Such faithfulness is not characteristic of all male sea-birds. Richdale records the adulterous visits of mated male albatrosses to neighbouring mated females with whom they copulated—but only so long as these females had not laid the egg. Violent physical desire plus proximity are often too much even for normally staid married couples in many species of animal. Ardent bachelors and mated males are always prepared to woo desirable females if they can surprise them unguarded by their legitimate males. This would explain the promiscuity of some male puffins at sea, where manœuvring freedom is large compared with that of the land.

We did not observe, however, that the puffin, mated or unmated, is notoriously libidinous, even in the period of four or five weeks of April and early May during which mating takes place. In a raft of many hundreds on 28th April we observed that less than ·05 per cent of puffins present were actually courting, attempting coition, or in coitus at any given moment, although this was two days before the general egg-laying period began. Yet it can be said that the puffin is certainly a loving bird, and although coition ceases after the laying of the egg, the affection of the mated pair for each other, as we shall presently relate, does not decline during their sojourn on the land.

* * * * *

We have seen that the newly arrived puffins do not land immediately. There is a waiting period in the raft of about one week. That is to say, the rafts appear inshore in the morning, never very early, usually from 07.00 hours (Greenwich mean time), increasing in density up to 10.00 hours, and then dwindling away and finally disappearing by about 17.00 hours. Even so, thousands may appear inshore one day, but on the next the puffins may not be present at all. This mass appearance, alternating with complete absence, is a puzzling feature of puffin economy. We have tried in vain to relate these movements to weather phenomena; but as they occur with an east or west or any other wind they must be associated with some other factor. This is most likely to be food. In the Faroe Islands these 'on' days are called the 'land-coming' days, and it is supposed that the puffins are feeding far at sea during the 'off' days.

Puffins do not seem to feed during these inshore rafting assemblies. But as they normally get their food by diving for it, and swallowing it under the water, it would be hard to prove—without shooting and examining some—this supposition that they fast at this period. Nevertheless they appear so idle in the rafts, diving but little (and chiefly to avoid a pursuer), swimming gently or resting on the surface, that we should be surprised if their stomachs were proved to contain freshly taken fish, or other small marine life on which they normally feed. Sea-birds, it is now well known, are capable of long fasts; their feeding periods are often short and satisfying and they do not normally hunt for food again until they are really hungry and empty stomached—perhaps after one or more days spent in digesting and assimilating completely the last heavy meal. It is no hardship therefore for the puffin to remain fasting inshore for a day or so, for as long as sexual excitement triumphs over hunger.

After five to ten days of rafting offshore, interspersed with retreats to the ocean, the first flights take place over the breeding-cliffs. Circling round and round their favourite bay or headland with characteristic fluttering flight, the puffins seem to be checking up on the situation ashore, taking a birds'-eye view of the location and state of the burrows.

In the air the short narrow wings are unsuitable for slow measured beating like that of the gull's flight. The puffin

N. Catford

The first landings, Skomer
(Skokholm in the distance)

G. Percy

The assembly in the Farne Islands

flutters rather than flies, with a quivering motion of the wing-tips, which move through a very short arc compared with that of wings of other sea-birds in the air. If penguins could fly their flight would doubtless resemble that of the puffin. In straightforward flight the legs trail backwards against the tail, webs closed; but in turning movements, the webs are spread each side of the tail and thus act as an additional rudder.

This fluttering becomes even shorter and more rigid of wing-beat as the puffin applies 'the brakes' and goes down to land. It may even glide for a short distance, but unsteadily, bumpily, for its narrow wings are imperfect sailplanes. Sometimes the typical vibrating flight changes to what has been called the 'moth' flight, which is really a variant of the shorter beating of more rigidly held wings on coming to land as already mentioned, and to be distinguished from the 'butterfly' flight of the razorbill described in the *Handbook of British Birds* as a 'peculiar slow wing-action quite different from that of ordinary flight.' Conder suggests that the 'moth' flight of the puffin is a form of display, since it is used especially 'when the birds landed in large numbers for the first time during the day, and also when the bulk of the birds went to sea for the night.' I found it used in so many situations, especially when the bird was alighting or taking off, and varying too in form between normal and moth flight, that it would be difficult to regard it purely as display. When a group of adults used the moth flight in close formation together, as they took off from or came to the land, then it did appear deliberate and the result of heightened emotion between sexually excited birds. But often a single bird would take off far from any others, and use the moth flight as if it found this more convenient than normal flight. There were no set rules. Often a bird hovered over the land with a species of stationary moth flight, as it sought the right spot to drop to earth.

* * * * *

About noon on the mysteriously chosen day the first landings take place, the incoming puffins concentrating on the rock outcrops which provide a prominent alighting and taking-off point overlooking nearby burrows.

For a while the puffins remain where they landed, in little parties resting on these rock heads which they last touched seven or eight months ago; standing and staring about them, like parties of charabanc excursionists let loose in the country but unsure of where to go and what to do. Below them rabbits graze in the afternoon sunshine, nibbling the bright green carpet of spring grasses and maritime plants among the hundreds of invitingly empty burrow entrances and exits.

After two-thirds of the year on the heaving sea does the puffin find the steadiness of the land strange? Is it pleasant for the pelagic sea-bird to rest upon the firm unmoving earth at last? What are the groups gathered on each little promontory thinking, saying, doing?

Nothing—or almost nothing. They have lain idly in the rafts when they first returned to the island, idyllically lazy or flirtatious. Now they seem to stand or sit about doing virtually nothing on this first touch-down on land.

It is simply a reconnaissance, a spying out at close quarters of the land, a reacquaintance with the topographical features of their puffin cities. They stand (or sit comfortably on the white breast, feet out of sight) and stare, swinging the head by jerks in a half-circle, to and fro, now and then yawning, now and then nodding as if to acknowledge the presence of a friend or a neighbour.

The silent survey lasts but an hour or two. Then, as if reassured that all is well, and as if recollecting an urgent appointment elsewhere, they quietly but quickly depart for the open sea.

Next day, or perhaps two or three days later, there will be a second invasion of the land, and the observer finds that the first shyness and watchfulness have disappeared.

All at once they are in and out of their burrows, as busy as bees on a hot spring day. They inspect, they dig, they spring-clean, they make love with their noses together.

Yet the early irregularity is by no means over with the second touch-down on terra firma. On the following day there may be no puffins visible on the entire island or inshore water. Then perhaps the rafts return a few days later; but there may be no landings. A second attack of land-shyness seems to overcome the puffins, which remain on the water, loving and mating freely, but otherwise idle.

One would suppose that if hunger were calling them away to sea there would be some regularity about these arrivals and departures, but these, as already mentioned, seem quite unpredictable and unrelated to the meteorological conditions. We must leave it at that, and return to our mated pair, which, after all these comings and goings, are at last settled down by the third week in April.

Frater and Cula took possession of a burrow a few yards from the cliff edge in the heart of the concentrations of puffins in Skomer South Haven. As soon as I had located and marked their burrow I placed an observation tent ten feet away from their front door. In a few days they got over a perceptible first shyness of the sackcloth and canvas box, and except on days of violent wind, when the material flapped a good deal, they ignored its presence thereafter.

CHAPTER VI

LUNDALAND

> I will make you brooches and toys for your delight
> Of bird-song at morning and star-shine at night.
> I will make a palace fit for you and me,
> Of green days in forests and blue days at sea.
>
> R. L. STEVENSON.

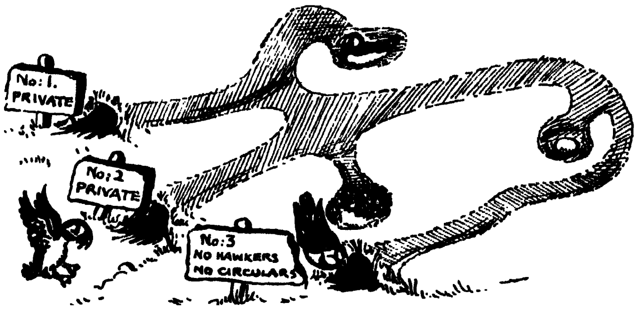
IT WAS a bright and beautiful scene, this *Lundaland* (pleasant Norse word for puffinry): the cheerful-looking puffins scattered on earth and water and in the sky between, the sun brilliant, a green day on the land and a blue day on the sea. The view from my tent covered both sides of South Haven where the sloping cliffs rose two hundred feet from the sea, clothed in the white maritime campion and murmurous with sea-birds: with large gulls, guillemots, razorbills, kittiwakes, and thousands of puffins. There was a spotted seal basking on the brown rocks at the edge of the sea. The surface of the haven was a bronze-blue at low tide, a colour gathered from the sky and the laminaria weed; and speckled with the white breasts and black mantles of the auks. Gulls yodelled, oystercatchers piped, and the auks groaned. The sea was quite silent on this late April afternoon; at low tide it was always quieter in South Haven as the foot of the cliffs was exposed, narrowing the entrance.

A few yards from me Frater was tugging at one of last year's withered clumps of fog-grass, vigorously wrenching at the tough stems. All around him other puffins gazed idly, some dozing with bill turned back upon the shoulder and eyes half shut. Now

and then one got up and visited a neighbour, walking with hunched shoulders and a gait so deliberate, one leg raised and placed before the other with an emphatic goose-stepping movement which over-exaggerated the importance of the mission it was embarking upon, that we in the box-tent smiled.

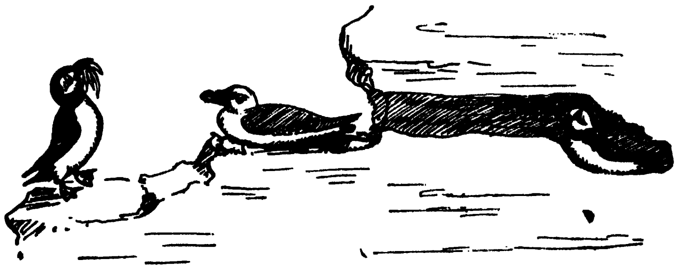
Here and there a puffin was digging a new, or improving an old, burrow. Using the bill as wedge and pickaxe, it loosened the earth, paddled it between the thighs and ejected it backwards in a fine shower with its broad webbed feet, which made splendid shovels. Now it would lie slightly to one side, now to the other, as it wielded these tools and widened the walls around the centre excavation. The dry earth flew out on the green lawn behind. But the work was as spasmodic as it was frenzied. The navvy frequently left the job and took a stroll among those which sat watching it at work, and which, staring with many a knowing twist of the head, seemed to say: 'Well, rather you than me! What a lot of hard work for nothing—there are burrows enough as it is!'

This was true. Here in the old-established colonies little excavating is required. The burrows have probably been in existence for centuries, changing shape from time to time as ceilings collapsed through natural causes, such as treading animals, burrowing rabbits, and rainstorms which softened the soil. Rabbits, however, are probably useful to the puffin; their excavations and traffic must help to keep the burrows open and in good condition for the puffins when they return in the spring, whereupon the conies retire before the formidable bill of the invader. But there are many islands where no rabbits exist, and the puffin must dig a burrow for itself, or repair one dug by a



predecessor. Except in the rocky areas where lack of soil prohibits deep burrowing the homes of the puffins have become labyrinths and catacombs as a result of these mining operations carried out over so many decades. Yet it was interesting to me to realize that however much branched and divided the passages were underground each pair of mated birds seemed to use but one entrance, which was also the exit, and no other puffins used that front door regularly. Often, of course, other puffins 'visited' holes other than their own (I have already said that up to seven puffins have been seen to enter one burrow), but not as a regular daily event. In short, each pair had its private entrance, no matter how much the corridors were connected underground. This area, from the small 'lawn' in front of the entrance all the way to the breeding or incubation chamber three to six or more feet underground, is sacred to the pair; it is their own territory, and will be defended vigorously against intruders. Later, as we shall see, when the passion and sexual desire of early spring are spent, the sense of possession wanes, and visiting by strangers or neighbours will be less resented than formerly.

We have never proved that two or more pairs of puffins were using the same entrance, but then we have not watched continuously more than a few selected burrows containing marked birds, and therefore cannot afford to be dogmatic in the matter. Puffins will, however, share the same rock crevice with razorbills, using the dark end of the house while the razorbills lived in the front rooms. Puffins likewise use the interior apartments at the rear of guillemot colonies; I found that fulmars laid their egg in the entrance to puffin burrows in the Westmann Islands (Iceland), to the great inconvenience of the puffins which were afraid of these powerful oil-spitting petrels; and in some of the more airy rock castles on Skomer, Skokholm, Burhou, and elsewhere



there are halls and pavilions wide enough to be shared in common by several pairs of puffins, razorbills, and even guillemots, each species occupying separate niches and nooks snugly within.

To return to our pair: Cula was sitting with her spotless white breast upon the turf at the entrance to her burrow. Here was a lawn of the special fescue which grows where puffins tread (*lundasina* it is called in the Faroes). It was well mown by rabbits. The flanking walls of the burrow were draped with small wind-proof and rodent-resistant plants: buckshorn plantain, sea-storksbill, pink or English stonecrop, thrift, sea-campion, and a little moss. She sat as it were in a miniature garden bower of her own. In front the lawn, and behind her the threshold of her home, a pathway paved with fine chips of the grey Skomer rock and with the round wind-dried inoffensive pellets dropped by the rabbits.

Cula could see Frater at his work, but she did not appear to pay much attention to him. She was tranquilly looking in one direction after another, as is the habit of the wild bird which must be careful not to be surprised by its enemies. But I doubt if she was thinking of her enemies. The view was magnificent—I have already described the appearance of Skomer South Haven at that moment—but I doubt if she was admiring the view. Far in the distance lay the long line of Skokholm's sandstone cliffs, where for many years I lived and watched among the puffins.

Could Cula see Skokholm, and recognize it as another great puffin metropolis? What was Cula thinking about as she sat there—or was she not thinking, but merely sitting, without any consciousness that she was a sentient being? I fear I shall never know.

Frequently Cula yawned, as if she were bored, displaying as she did so the lemon-yellow of the interior of her mouth. But there was no one close at hand to admire this vivid, surprising disclosure. Frater was too busy.

Cula rose and flapped her wings. . . . Now, I thought, she will do something interesting. But she sat down again.

Frater was accumulating a bunch of withered grass quite as large as his own head. As he pulled each straw free he imprisoned it in his jaws, so excellently adapted to hold firmly a large number of long thin objects. Suddenly he dropped the bunch.

At that moment a third puffin pattered towards Frater's rear,

and made a tentative peck at the bright aluminium ring on his right leg. Rising almost to full height Frater looked ridiculous as he appeared to fling the intruder a glance of hauteur. Frater cocked his tail, grabbed part of his load, and, turning away from the inquisitive busybody, stepped mincingly towards his Cula.

She rose, as if she had noticed him for the first time, and ran a few steps to meet him. She gave a pull at his mouthful. He swung his head impatiently, as if jealous that she might steal his fine load, so laboriously gathered. He pushed past her into the burrow and disappeared.

Cula followed him but stopped on the threshold. Bending low she peered inwards. She nodded her head up and down, craning her neck in an endeavour to follow his movements. Her attitude of 'Well, what on earth does he think we can do with all *that*?' was extremely amusing.

If she heard my discreet chuckle she gave no sign, but continued to jerk her head and crane her neck until Frater reappeared—with the load still intact!

Sometimes, to while away long hours of watching birds I have been foolishly tempted to interpret their behaviour in terms of human conversation. For instance, when Frater came forth with his bundle he seemed to be saying: 'So! You aren't coming indoors to arrange this wonderful contribution in the nursery? Isn't it a fine enough bunch I have gathered for you?' But to do this would be falsely sentimental and wrong; there is no evidence that birds are reflective and intellectual at human level—and the subtle silent gesture language of the puffins escapes us.

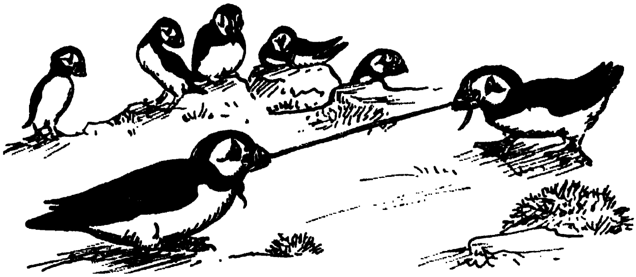
Cula gave the bunch another peck but, as if determined to get the utmost approval and admiration for his hard-won load out of more appreciative neighbours, he made a parade up and down, and to and fro, within four square yards of his own front door. Cula took a few steps towards him at first, but as if thinking better of it sat down again and yawned. She started to preen, not improbably as a nervous reaction.

The neighbours were definitely interested. One after another the nearest to his line of sentry-go ran up to Frater and pecked at the billful of grass, or attempted to. He avoided these advances, and pattered around, as if tremendously pleased with himself. He probably was. We ought not to deny him a human weakness, even if we will not allow him a human virtue. If the reader knows of a better interpretation, then let him apply it. In ours Frater was simply behaving as an energetic and happy child who has collected a bundle of fairings.

Here and there other puffins were plucking material: grass, leaves, a feather, and one had a stone in the tip of its bill. Some of this was carried indoors, most of it was finally discarded and allowed to blow about in the gentle sea-wind until it was picked up by others, trodden underfoot, or vanished over the edge of the cliff. As a man walking down a lane with a maid plucks and chews a grass nervously, or gathers a bunch of flowers and then forgets and drops them, and thus relieves his emotional tension, so the puffins discharged some of their surplus nervous energy by playing with nesting material which they did not really require.

Cula became interested, not in her husband's massive beakload, but in a single straw about fourteen inches long which a neighbour (a small-headed female) had secured and was toying with. She stepped over the way and took one end of it in a deliberate, possessive manner.

A tug-of-war began, each wrenching at her end in turn so viciously that the other was tugged forwards. It looked as if the



straw would snap before a victory for one or the other might be won.

'Stop!' I wanted to cry in the midst of laughter. 'You must mark a line on the ground in the proper way, and she who pulls the other across must be awarded the straw!'

This time my chuckles were so loud that the owner of the straw gave a little jump backwards and relinquished it. Cula, less alarmed because she was well used to the curious noises from my tent, found herself in undisputed possession of the trophy. Intentionally or instinctively (we know not which) she instantly dived into her burrow with it.

A great black-backed gull swooped low over the tent and caused a local alarm in which a hundred or more puffins took off into the wind.

These little alarms were constantly happening. Sometimes I was the cause, on approaching or on leaving the tent. But any large bird, swooping low, would send the puffins into the air for a short cruise. One by one or in small parties the puffins would return, dropping down from the sky with ordinary braking or sometimes moth flight, from the whirring circling stream in the sky. The first to return would always be a little nervous, and would run to its burrow entrance, ready to make a quick dive below if the alarm was renewed, or to take off again. In the most sudden alarms those nearest their holes plunged below in panic, often clumsily bumping into the walls of the entrance with wings imperfectly closed after being opened instinctively for escape.

These sudden flights also occurred for no reason apparent to the human observer. A hundred or a thousand puffins would take off from South Haven and circle downwind over the sea, wheeling back head to wind over the burrows like aeroplanes coming to land which use the headwind to check momentum. Many if not all of these unalarmed mass flights are without doubt emotional in the sense that they are the result of keyed-up excitement in a social species. They are joy-flights, aerial games divorced from ordinary sexual display; these play or recreation flights are culminatory, and, like the consummation of the mated pair, release energy, which will be gradually built up again after a period of rest.

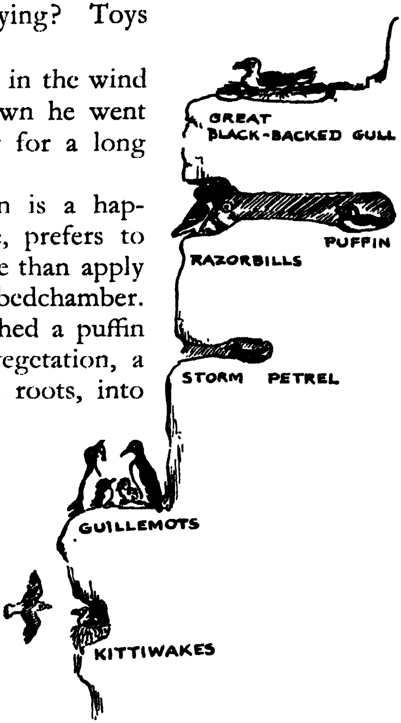
On the sea the same thing would happen: all the birds in a certain raft or even the whole of a bay would suddenly take flight, with or without provocation from an enemy; or they would, as described on page 24, dive simultaneously. Often the excitement was more obvious on the water; when the puffins, guillemots, and razorbills reappeared (for sometimes the three auks dived together) you could see that their tails were cocked up and their heads had assumed exaggerated or ecstatic angles. In the spring these mass dives were frequent, and sometimes followed in quick succession, as if enough energy had not been released with one performance.

Joy-flights were evidently more exhausting than joy-dives. It required a spell of many minutes at the burrows before the puffins were sufficiently rested and restive to make another aerial sally. Such flights were not confined to the puffins, although most noticeable in them because they were the most sociable sea-birds on the island. Razorbills and guillemots, before egg-laying, indulged in joy-wheels in the sky over the bay. Other sea-birds do the same, especially kittiwakes, and gulls and terns generally. Black guillemots make sudden unaccountable flights together. Rooks and daws conduct aerial manœuvres which have been variously interpreted but which seem to be simply joy-flights rather than 'dreads' or 'panics'—names which have been given to the strange mass risings into the sky of a host of breeding terns.

On his return from the sky Frater dropped accurately in front of his burrow. He had only a few scraps of his fine load of withered grass left in his bill, and now he set about replacing the lost material. He ran to the same source, but this time plucked furiously at green stems.

Suddenly he stopped, marched to the burrow entrance, and, shaking his head violently, scattered the fruit of his labours to the wind! Cula had signalled to him with the long low laugh which is almost the only sound uttered vocally by the puffin, a rolling *Aar-ha-ha!*

What that laugh conveyed in this instance we cannot be sure. But that he recognized her voice was certain. Was it mere coincidence that he immediately dropped his load? Or was it that he was suddenly aware of his wife and the desirable home which he shared with her underground? She could not, surely, have told him in those few growling words (the first a note or two higher than the last) that she had found a much more suitable straw for the nest and that he had better come and see (but can a puffin see anything clearly in the dark or semi-dark of the burrow?) for himself how impossible it would have been to stuff the nursery with the junk he had been carrying? Toys for her delight, indeed!



Leaving the straws to blow in the wind about the streets of puffin town he went below. He did not reappear for a long time.

Nest-building by the puffin is a haphazard business. He, or she, prefers to toy idly with material far more than apply it industriously to lining the bedchamber. How often have we not watched a puffin carry grass, seaweed, dried vegetation, a feather, a beakful of dirt and roots, into the burrow, only to drop it in the passage, or bring it out again. But why? Why such a waste of effort? Is this behaviour vestigial, a relic of the behaviour of ancestors which laid coloured eggs in more open situations, where a substantial nest was built?

To-day the egg is laid on the bare earth and hardly any lining remains to comfort the sitting bird, or the chick.

CHAPTER VII

THE LOVE-BIRDS

As fair art thou, my bonnie lass,
So deep in luve am I:
And I will luve thee still, my dear,
Till a' the seas gang dry.

BURNS.

FRATER was as uxorious as any husband ought to be. The demonstration of love in the bill-rubbing performance, which we have already witnessed at sea, was best seen on land. In the water the male was apt to push his partner so hard that she was unable to maintain a suitable position for more than a second or two. But on land Cula could dig her sharp claws into the turf and stand up to this affectionate pressure. Frater would advance, at first with his head slightly quivering and tilted forward in a kind of bow; then if she was responsive he would raise his bill to meet hers. Face to face now, he would thrust his great red nose against the lower part of hers, as if trying to lever her upwards, almost as if he wanted to get beneath her breast. She, resisting him, would keep her bill pointing downwards, pressed against his, which he shook rapidly from side to side. She thus sat closer to the ground than he did, and her bill remained always on one side of his, she pressing sideways and forwards to counter the nuzzling action of his bill. It was not a clashing or fencing of bills as it is sometimes described to be. The bills remain locked together, his left side on the right of hers, or vice versa.

Although he usually initiated the billing ceremony she appeared to take pleasure in it. You might indeed see her bill begin to

sway in response to his approach even before nuzzling commenced; and afterwards both her and his bills might go on quivering for a moment after they were withdrawn, and their stumpy tails, elevated during the ceremony, might remain elevated.

Mated puffins are affectionate birds, as affectionate as the parrots, which they superficially resemble, and which nibble and cosset bill to bill. Budgerigars or love-birds are notoriously amorous and sociable; puffins might appropriately be called the love-birds of the sea. Like the budgerigars, they display a deep interest in both their own and their neighbours' love-affairs.

Neighbours were immediately excited by a bout of billing, and, as in the raft at sea, they would hasten to get an intimate view. They would close in eagerly, until their bills were almost and sometimes quite touching those of the loving pair. It was delightful to watch the vulgar craning of two or three or four of these spectators, and the sudden awareness of the lovers that their privacy was over. The billing would stop. The lovers would raise their neck feathers slightly, like dog or cock showing readiness to do battle, and gape threateningly—or the male alone might do this and make a lunge at the intruders. This usually dispersed the bystanders, and also ended billing for the time being.

Often it would be a lone bird, a big-head or male, which would be the first to join with the billing pair. If so he might be embroiled in a clinch with Frater (or any other male interrupted in these legitimate amours), who, with a growl of intimidation, would grab the upper or lower mandible of the intruder and savagely wrench the head, twisting it so that it was almost at right angles to the body. Wings would be slashed at the same time. The combatants might roll and tumble downhill and over the cliff edge, separating in mid air. Or they might unclasp, only to clinch bills once more, and growl and twist and turn for a few seconds, then separate and gape at each other threateningly; and then perhaps the intruder, as if aware that he was the guilty party, would back away, or sidle, with hackles raised, and beat a not undignified retreat.

In no instance did fighting result in more than superficial damage, in spite of that formidable bill which can draw blood from the human hand. Undoubtedly the males were more ready to start a fight than the females. It was the males who seemed to be boldest in interfering with connubial billing. I am not altogether sure enough to generalize, but I believe that the females were more passive, and seldom fought with each other, or female with male.

In fighting the beak grip was usual, but sometimes, as in a film which I made, an intruding male surprises a billing male by grabbing the back of the neck. Even so, few or no feathers fly.

Fighting, in its turn, stimulated the curiosity of nearest neighbours, and more often than not was ended in the same way as billing, by the intrusion of one or more third parties. Neither billing nor fighting could last long in a populous colony because of this inordinate curiosity of neighbours. Again and again Frater attempted to nibble and nuzzle Cula's bill, but as soon as he had established a good contact with her a neighbour interfered. The only safe place for undisturbed billing would be in the depth of the burrow, where, of course, it is impossible to observe the pair. We saw no sign to indicate that billing took place anywhere except in the open.

Like every other puffin Frater himself was possessed by this inquisitiveness. I saw him sitting alone outside his burrow one afternoon early in May, evidently bored with his own company. He frequently stood up, flapped his wings to the accompaniment of raising his black head and neck feathers and partially closing his eyes at the same time, like a human being stretching after a long rest. Sometimes he shook or shivered his head as if he felt his skin 'going goosey,' as the saying is—another human-like trick commonly indulged in. His red feet were close together, the inner toes overlapping—this was the resting position; but, almost losing his balance in this position, he now stood more squarely, placing his webbed feet about one inch apart, in the usual standing position.

He must be up and doing. He looked around restlessly. He must find some way of relieving his re-created energy, some useful task or some substitute activity as an emotional outlet.

Suddenly seized with an idea, he pattered across the burrows to where a neighbour was sitting peacefully outside a hole close to the tent. Frater went cautiously up to this bird, looked inquisitively in her face, and gently plucked at the cerise eye-ring. I saw the sitting bird open her bill in the threat attitude and thrust her head slightly downwards so that the neck was raised and the hackles open. (Strictly speaking the puffin has no hackles; I refer to the small feathers at the nape and base of the skull.) Still Frater was curious, and, ignoring the hostile signals, he again plucked at the fascinating eye. This was too much for the sitter's peace of mind. She suddenly leaped upon Frater.

After all she was on her own front doorstep, and standing, so to speak, in her own rights. We have said it is incorrect to attribute to birds human feelings and moral criteria; but no one witnessing this, and many similar incidents of intrusion, could have doubted that some sort of right and some kind of fear were there. Frater knew he was intruding, and the sitting female knew that he was and was also aware that this was her own plot of God's earth, which fact gave her the appearance of moral righteousness and the strength to repel him. He, guilty, and uneasy because he was not on his home ground, did not stay to argue. With head down and neck arched, he leaped backwards as she sprang at him. Diplomatically, with this slight show of anger in his raised hackles, as if he would say 'You dare to bully me, you hussy!' he retreated.

I fancy she was female, by her small size, but I cannot be sure. Frater seemed to behave towards her playfully rather than adulterously. But she was so much smaller than he that it seemed absurd that she should be able to repel him. Might, however, is not always right. I have seen the fragile flycatcher drive away a cat which was stalking her young fallen from the nest. It is an excellent safeguard of nature that the bullies should only be successful bullies when they are psychologically at ease, as in their own homes and territories, and should become cowards when they go abroad. Time and again the battles between puffins were won, not by the agency of physical might, but by moral right.

Frater moved back from this curious encounter, and standing a yard from his own front door, nibbled the oil gland above his tail with the tip of his bill, tail twisted towards his head in the effort. I could see the prominent oily knob. Having thus primed the horny bill he proceeded to rub every part of his plumage with what was to me the invisible oil; that is, every part he could reach with his bill. But the crown and back of the head,

the chin, and the throat he could not reach. Nevertheless by rubbing these over the already oiled mantle, and by rubbing the back of the head in the oil gland itself, he succeeded finally in waterproofing each superficial inch of his plumage. Not satisfied with this he preen-oiled many if not all the single large feathers of the wing and tail also, drawing them one by one through the greasy bill.

This took many minutes. Afterwards he resumed his bout of yawning and wing-flapping.

Spotting a bill-rubbing pair four yards away he trotted towards them eagerly. He stopped and made a threatening movement as he came near, a bowing of the stiffly held head sideways in that uncomfortable position a man assumes when the barber pushes his head down in order to clip the neck-hairs. These pauses with bending or bowing attitudes seem to signify mixed intentions: first aggressiveness, and behind this amorous desires. 'I am ready to make love or to fight—which do you prefer?' Frater seemed to be saying as he confronted the nuzzling pair. 'I could love the woman and destroy the man.'

Unfortunately for this piece of attempted thought-transference on my part, the pair, for once, ignored Frater. They moved, billed, moved, and billed again; evidently they were not quite on home ground and therefore they were not interested in defending territory. Each time Frater goose-stepped forward they retreated, billing as they went.

Tired of this unprofitable chase Frater turned back for home. He yawned. He flapped his wings as boredom again descended.

So much of his behaviour was amusingly human. Here was Frater, out of curiosity, high spirits, and lack of more essential employment, exploring the territory of a neighbour, but now grown uneasily aware that the farther he permitted himself to wander the more he was in strange and therefore dangerous country, with his home left unguarded far behind him. Four yards in any direction from the mouth of his burrow was safe ground; beyond that his ambitions were timid.

Encountering a thread of dead grass he picked it up and marched to and fro in the vicinity of his own front door, carrying the silly little wisp in his enormous bill. His face, to the watcher in the tent, had acquired that fatuous appearance which a man's sometimes assumes when he is doing nothing with great importance. And thus for a while Frater dissipated his store of energy.

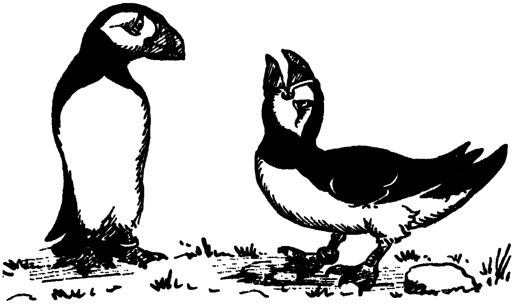
'Nothing of great importance' happening—this was a common state of affairs in the colony. Cula was nowhere to be seen. From a neighbouring burrow two puffins emerged, both with soiled shirt-fronts, gazed round as if surprised about something, and took off to sea together.

A little later there was quite a shower of puffins falling around the tent, and I saw two clean-breasted individuals enter the burrow from which the soiled shirts had emerged. Then a third entered, but almost at once reappeared, followed by one with an earth-soiled breast who fairly leaped forth, as if ejected by force, and flew away.

I recount the observations of the last few paragraphs as they appear in my diary, simply to illustrate scenes in the normal social activity of the colony. Nothing of great importance . . . What did this visit of three puffins to one hole mean? Did that particular hole lead to more than one nest-chamber? Perhaps the burrow was a failure as a nesting site—the soiled breasts told me that it was wet inside—and perhaps it was anyone's property now? The third bird was there out of curiosity?

All the sunlit afternoon the outdoor gathering of the puffins multiplied in strength. The shadows turned round the rocks from west to east. More and more puffins were alighting or coming out of the burrows. Most of them sat quietly, breast lying partly on their flat paddles and partly on the grass. They dozed, eyes half closed; or with bill tucked under the wing-scapulars, appeared to be half awake, half asleep.

The characteristic upward flick of the head, used often when a



N. *Tinbergen*

Turning in flight: the webbed feet act as an additional rudder

N. *Catford*

The silent yawn of boredom

male approached a female, but sometimes by both birds together, seemed to be somewhat infectious. Idly sitting birds would do it as they watched their neighbours at courtship. When the head-jerking was near enough to the tent I could occasionally hear a faint pig-like grunt with each flick.

The long-drawn *Aar-ha-ha* came from birds underground more than from those above. Frater gave an excellent performance more than once, close to the tent. It could be seen then that the first syllable was an inspiratory one, for the breast visibly welled with the *Aar*; but the ending double note *ha-ha* was expiratory, with the chest deflating. Man can give a very good imitation of the puffin's voice by drawling these syllables as the puffin does, filling the lungs on the first, and emptying them on the last, notes. My own attempts deceived the puffins, or so I believed; but as the whole 'song' of the puffin seems to have no one special function and is uttered rarely, but in many situations, with the performer quite solitary, or among a crowd, there was no greater attention paid to the imitator than an inquisitive glance at the tent from which the sounds came.

More significant to me seemed the very faint but distinct creaking or gurgling noise which accompanied the opening of the beak when one puffin displayed its lemon-yellow or flesh-yellow mouth towards another. This might be called the 'threat' yawn, because it was most often seen when one male was warning another to keep his distance. But females were observed to 'threat' yawn. Other auks yawn at each other, the razorbill showing a chrome-yellow interior, the black guillemot vermilion, the common guillemot and little auk flesh-coloured. The 'threat' yawn was distinct from the ordinary yawn of weariness of a sleepy individual firstly by reason of the gurgle or creak, which might have been instrumental but was probably vocal, and secondly because it was 'held' (jaws open and head-feathers slightly puffed to give the bird a more bulky appearance) for much longer than the yawn of weariness—which lasted for a period even shorter than the average human yawn and was silent.

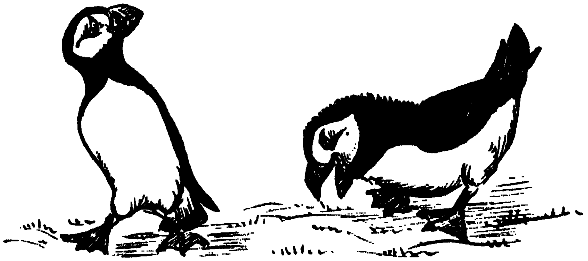
I tried out a few simple oral tests. Soft whistlings, nose-sniffing, scratching of boots together, they ignored. Increasing my voice to about normal conversational pitch, I recited poetry. This made puffins within four feet of the tent cock their heads sideways like dogs, listen, and walk a few steps uneasily, some towards me, most of them away. But they were not seriously alarmed at Shakespeare, Robert Louis Stevenson, or W. B. Yeats. In a few minutes they were definitely bored, and paid no further heed to the monotonous recital, which mingled with the gentle song of the sea on the rocks below.

I was left to reflect on the meaning of the puffin's inarticulateness and long silences.

Do puffins communicate with each other in a sign language at least as intelligible as that of the bees and ants? Some birds have an extensive vocabulary of call-notes, song, and fear and warning notes. The jackdaw, according to Konrad Lorenz, has a language by which it expresses its moods: happiness, love, fear, sickness, anger, jealousy, enticement, wanderlust. But the puffin, except when fighting or announcing its presence in its burrow, when it growls expressively, is almost silent. Its communications with its mate and neighbours must therefore be largely in the deaf-and-dumb language of signs, chiefly of movements of the remarkable bill: yawning, fixed gaping, billing, tossing of the head or cocking of the bill, lowering of the head stiffly, and raising of the neck-feathers.

The origins of many ceremonies can be traced to familiar actions during the early dependent period of the bird's life. Some courtship billing is said to have arisen from the feeding of the chick by the adult. Threat gestures may be derived from instinctive mimicking or learning these actions in the parents, or enemies, which threaten or drive away the juvenile at fledging time. As the bird matures these gestures may be formalized and with slight alterations become functional for quite different purposes.

That gaudy bill is possessed by both sexes. Its flaming colours cannot be without special significance; it dominates the life of the puffin during the sexually and socially active season; afterwards it is not wanted—it fades and part of it is moulted during the period of solitariness in winter. The puffin is almost a silent bird. If we take these facts together it seems clear that the wonderful bill is not only an advertisement and a stimulant, but also the chief instrument to convey signals, between individuals, in default of the normal vocal code used by the majority of birds. Watching the display habits of the puffin I find that when this bird wishes to attract the attention of its mate it turns its head upwards with a jerk, like a signaller waving a flag. 'I am here, take note! Do you see me?' the jerking head seems to announce. But if the bird is a stranger or rival, the bill is held stiffly forwards and downwards, showing the colours frontally towards the enemy: 'Be careful, another inch nearer, and I shall attack you!'



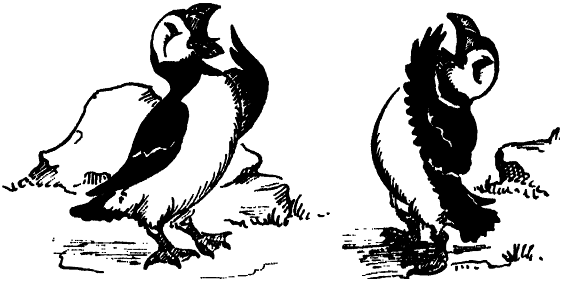
These are the clues; and the peaceful and warning attitudes of other animals show great similarity. We have already described how the black-headed gull, with its bold hood of chocolate and white eye marks and bright beak, confronts a rival with head thrust forward and all this colour conspicuous. The gorgeous-hackled farmyard cocks adopt the same attitude; so does man's ally the dog when it approaches an enemy with lips drawn back in a snarl, fangs exposed, and neck-hairs erect. But what happens when a friend or mate appears? The gull turns its head away, exposing the vulnerable white throat, the dog rolls over on the ground, turning aside its head and surrendering the region of the jugular vein to the mercy of master or mate. These are gestures of appeasement, and they are necessary in social species in order to minimize wasteful fighting; the turning away of the aggressive colours and weapons inhibits the will to fight. The gregarious puffin has a similar code of signals enabling it to live in dense communities without serious strife. Konrad Lorenz has shown that in less social species, such as the roe-deer and the turtle-dove, escape by flight is the correct reply to the signals of aggression in a dominant individual. If a strong roebuck is confined in a small pen with others of his kind, therefore, he will kill them, and he will attack a man persistently enough to be dangerous. A turtle-dove in a small cage with another will peck the weaker bird to death. But savage wolves live together as amicably as do puffins, because their innate sociality is built upon a pattern of appeasive behaviour. Two male puffins which I placed together in a small box fought for a couple of seconds because of their closeness which violated the territory of individual distance, then the weaker one retreated to one corner, while the other made no attempt to molest it.

The significance of the movements of the puffin's bill begins to be clear: the head-cocking is an appeasing action, it turns away the conspicuous face, exposing the neutral white breast and the very plain black bib; it is a signal of peace between mates and neighbours. The holding of the head forwards and slightly downwards, the raising of the neck-feathers, and the stiffening of the body, on the other hand, is a threat display. A puffin which has struck the threat attitude presents to an approaching stranger or rival the fullest aspect of the gaudy colours of the face, bill, and crown; and the visitor usually takes the hint and moves away.

But all is not quite clear yet. The love-habit of nose-rubbing is not explained: in order to begin this the head is often held forwards and slightly downwards; and outwardly all the signals of warning are there. The loving male approaching the female might appear to her to be about to attack. Somehow the threat gesture must be turned into one of love. Perhaps the female of the species likes to be threatened and dominated by her mate who, in the puffin, is certainly the strong silent type? And of course she can always run away?

But this is too clumsy an arrangement. The male cannot and does not waste his time approaching the female with his bill down, and then when she retreats raising it in the appeasing movement (although something of this sort may occur in early spring during the flirtations in the raft at sea). No, as he draws near he begins to vibrate his bill with little side-to-side movements. So long as he waggles his bill in this way, however slightly, she seems to recognize that his intention is amorous, she is stimulated by the approach of his conspicuous head, and if she is feeling amiable she responds with the same movements. Finally there is another safeguard—on land the puffin rarely approaches an enemy in the threat attitude; it is more usual to strike this attitude in a standing position on the approach of a stranger invading territory or individual distance. The mood of a *moving* puffin, therefore, is seldom bellicose; it is usually peaceful, amorous, or merely one of curiosity.

The holding of the mouth open in a fixed gape or yawn with the tongue in view, and sometimes accompanied by a very faint creaking or gurgling note, heard only if the observer is very close to the bird, seems to be a mild form of threat or warning. This type of yawn, lasting for a few or several seconds, is probably a preliminary or incipient part of the typical threat display, attaining its present significance as a secondary warning sign because of its convenience and economy of movement. Puffins also yawn naturally, and for the same reason as other birds and human beings yawn. Yawning, wing-flapping, and preening movements of the puffin are the close equivalents of human yawning, stretching, and scratching movements. But at times the puffin seems to preen and yawn unnecessarily, perhaps unconsciously, as a substitute activity or emotional outlet when in the presence of others, just as men and women half unconsciously scratch and yawn to hide fear, excitement, or embarrassment in the company of their fellows.

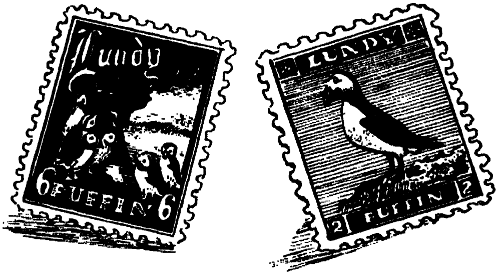


It was time for me to go back to the island house for supper. I pitched a small lump of earth through the observation hole in the tent as a hint that the gathering might disperse while I crawled quietly away, unobserved or less observed. The only notice taken of this, and of other and larger lumps of earth which followed, was an eager inspection of the same by one or two of the nearest, and an inquisitive pecking as if to test their nature.

Could this fearlessness be explained by the fact that small objects, and especially pellets of excreta from birds passing overhead, are constantly falling from the sky? I thought so. In that case it might be interesting to discover how large an object must be before the assembled puffins took fright.

When I threw my note-book, which measures approximately six inches long by four wide and half an inch thick, towards Frater, he and some fifty of the nearest puffins instantly flew away in a compact flock.

I was free to depart without further alarming them.



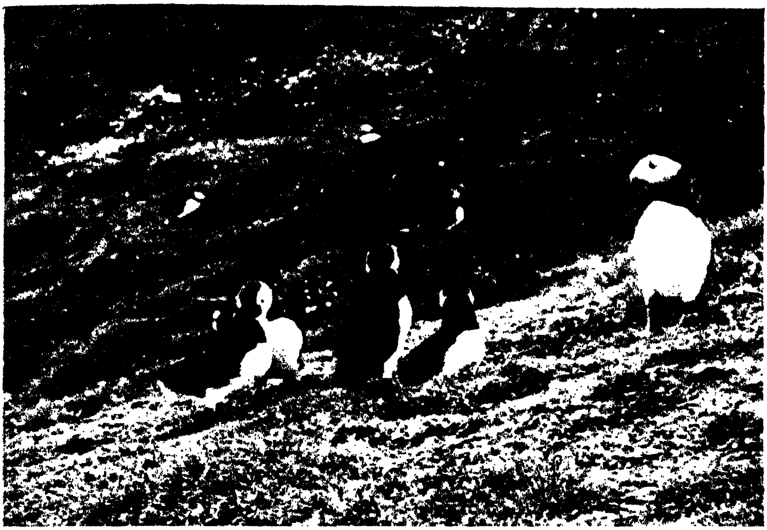
Stamps issued by the proprietor of Lundy Island, surcharge on outgoing mail.

N. Catford

The billing ceremony: 1, the invitation

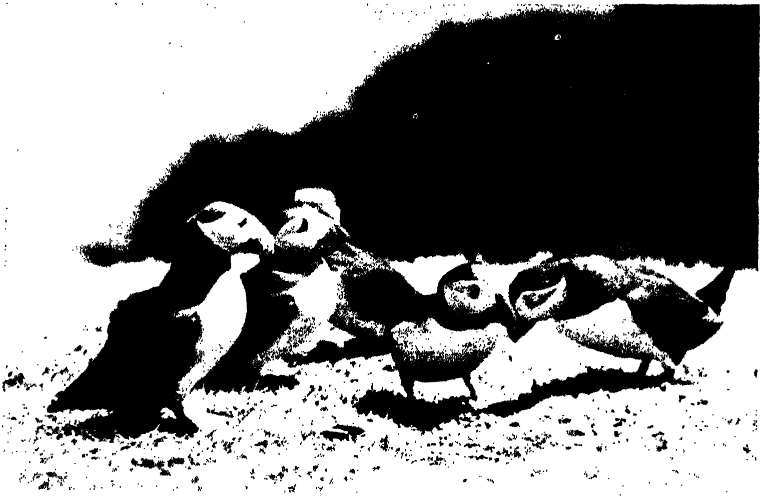
R. M. Lockley

The billing ceremony: 2, getting down to it



R. M. Lockley

The billing ceremony: 2, back view—spectators are interested



P. J. Conder

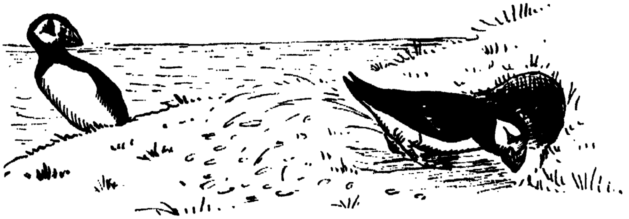
The billing ceremony: 4, spectators about to interfere

CHAPTER VIII

THE INCUBATION

> Thou shalt have a place without the camp, to which thou mayest go for the necessities of nature.
>
> *Deuteronomy* xxiii.

FRATER'S wife Cula appeared at the entrance to her burrow, looked round hurriedly, took three steps backwards into the open, with force and noise eased herself of a substantial burden of offensive matter, and immediately returned to duty underground.



I knew by this action that she had laid her single, large, white, faintly spotted egg, and was incubating.

What I had tried to discover for some years was the part played by the male puffin in incubation. For, despite its tameness in the open, the puffin proved shy when a shaft was sunk to open its earthy burrow and an artificial lid of turf was placed over the nesting recess for observation purposes. It had deserted all but three of more than twenty nests which we had opened and tried to study in this way in past years. It resented being handled in the burrow for the purpose of checking its ring number, with the result that I had to curtail my examination of the brooding birds in order to secure accurate incubation periods. But those birds which I had ringed and recaptured later at the nest had so far always been the same—the small-headed females.

Now in 1946 I was to find that in four shallow burrows at Skomer which I had opened and kept under intermittent observation both male and female incubated, but that the female took the larger share. All birds were ringed as soon as caught at the nest incubating.

In nest A, three visits, male first time, female second, nil third.

In nest B, twelve visits, male thrice, female five times, bird escaped once, egg cold twice, egg missing last visit.

In nest C, four visits, male once, female thrice.

In nest D, two visits, male once, female once.

Males were noted on egg at all times between 08.30 and 19.30 hrs. G.M.T.

This was in accordance with the general trend of activity observed outside the burrows, where Frater appeared to spend more free time than his spouse. I did not at first attempt to open their ancient cliff-side burrow; I had found by testing it with a long flexible wire that it was, like all these immemorial puffin dens, deep and probably labyrinthine.

From the fact that Cula was already sitting hard, I estimated that she had laid her egg in the first few days of May. As I had found the incubation period to be between 40 and 43 days, it would hatch about mid June.

In handling incubating adults at the nest I had discovered that the puffin, to my surprise, possessed not one large brood-spot, but two extremely small ones, difficult to discover. The brood-spot is an area of skin which becomes denuded of feathers in the breeding-season a short time before the egg is laid. Against this spot or cavity in the plumage the brooding bird shuffles the egg, which is thus kept at the steady temperature of the body which is requisite for the development of the embryo chick. This is fever-high compared with that of the human body. In an adult brooding puffin the temperature of both the brood-spot and the interior of the body (rectum) is 108·2 degrees—from tests which we made at Skokholm on 8th June 1948.

But why should the puffin possess two brood-spots and yet incubate but one egg? Occasionally, but very rarely, two eggs have been found in the nest of a puffin. Perhaps we ought to examine the position with others of this ancient Eocene tribe of the auks.

The common guillemot, nesting on sheer cliffs, ledges, and the flat-topped isolated stacks, lays one large highly decorated egg which it holds in one large incubation patch, at the base of the breast-bone and between the thighs. But the black guillemot, laying two speckled eggs in a roomy sheltered crevice, has two brood-spots, one on each side of the sternum. The razorbill also has two brood-spots, but lays only one very large decorated egg (very rarely two have been found in the same nest, but this is no proof that both were laid by the same hen), which it incubates, like the puffin, under one wing, half crouching, half leaning over it in order that one of the brood-spots, which are very small and situated between the thigh and the base of the wing near the edge of the white breast plumage, and thus far apart from each other, may be in firm contact.

The extinct great auk, which resembled a giant flightless razorbill, laid a large egg as highly decorated as that of its smaller congener, but had only one large brood-spot, situated, like that of the guillemot, between the thighs. Because it was flightless and laid its egg in an exposed and accessible position, the great auk perished from all its breeding-grounds in the Atlantic, leaving behind some 80 skins and 75 eggs in the world's museums. But the fast-flying little auk, abundant still in the inaccessible high arctic, usually lays one bluish egg well concealed in a hole or crevice in the cliffs, and incubates it, like the puffin and razorbill, against one of two small brood-spots in the same situation, near and above each thigh.

Our puffin's egg, as often happens in species nesting in comparative darkness, is white, with a dry limy surface; this white coat, on a close inspection, is seen to cover a zone of faded lilac or pale mauve spots about the largest diameter. The empty shell, under strong illumination, shows this pattern of markings—as rich as those of the egg of the razorbill. (The eggs of other puffins—the tufted and horned puffins of the Pacific—are similarly white, with pale spots and blotches.) The ground colour is rarely a deep cream or pinkish, and rarely scrolled, rather than spotted, with faint lines. It is a little smaller than, but much the same shape as, that of the razorbill. Average measurements of 100 eggs of British breeders: 60·8 by 42·29 millimetres.

All these facts are suggestive to the student of evolution. The faded markings on the eggs of the puffin, and the two brood-spots, and the occasional appearance of two eggs in the burrow, would indicate evolution from a period when the puffin laid two highly coloured eggs in more open situations than at present. Decorations, scribblings, blotches of brown and black, and other neutralizing tints are generally held to be protective, and they are at their best on the eggs of those species which deposit them in the open, as gulls, terns, guillemots, wading birds, nightjars, larks, and pipits. The white of the eggs of hole-nesters such as puffin, woodpecker, house-martin, swift, bee-eater, hoopoe, roller, and owls serves a different purpose: camouflage is not required, and the whiteness is an advantage, enabling the owner to find the eggs more easily when returning to the semi-darkness of its home. In lesser degree the pale blue of the eggs of some species nesting in holes near the light, such as wheatear, redstart, and little auk, provides a similar advantage of conspicuous colouring in a somewhat less safe situation.

But consider, you may ask, why is the protectively scrolled egg of the razorbill often laid in a safe rock crevice? The answer seems to be that the majority of razorbills still lay their eggs in situations as open as those of the guillemot, and in fact the two species often incubate side by side on the same exposed ledge. Evidently the puffin has progressed farther than the razorbill towards hole-nesting, from an earlier, probably ice-age, epoch of open-site nesting. What were the causes of such a change can only be surmised, but the simplest hypothesis is that as the ice retreated northwards the puffin, which is well recognized to be an arctic species (more arctic by far than the razorbill and common guillemot), was left breeding on islands and cliffs where the soil was no longer frozen all the year round; and, being active terrestrially, this modern puffin began to dig in the soft turf, and found better cover for rearing its chick underground. So the egg lost its colour by degrees. However, this is not a very satisfactory explanation; by this theory puffins nesting in more exposed sites in the debris of frozen cliffs in the high arctic to-day should have more protectively coloured eggs than the southern puffins; and as far as we know there is little difference in the markings on the eggs of the three subspecies (*naumanni* in the far north, *arctica* in the centre, and *grabae* in Europe). All three subspecies nest in holes to-day.

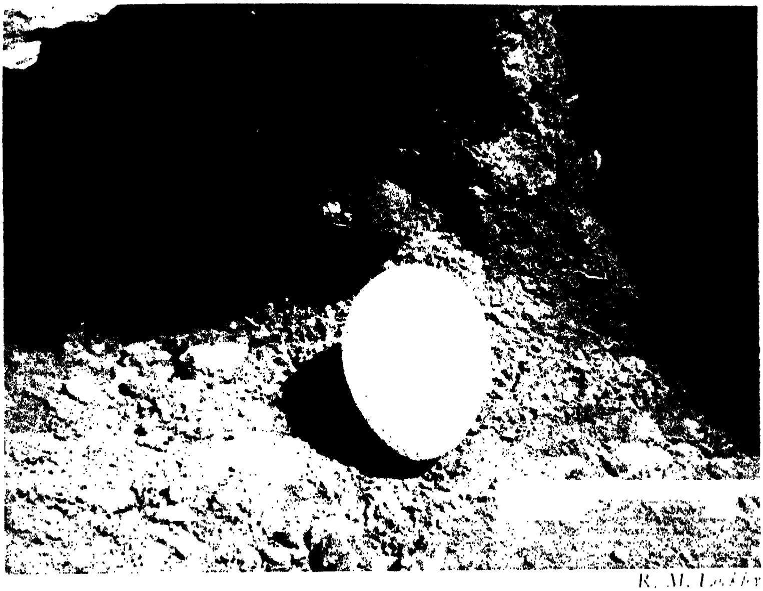
There are signs that all the auks in the Atlantic are declining in numbers in the southern part of their range. This is true at least of the puffin, razorbill, and guillemot in the British Isles and the eastern seaboard of Canada. This decline is put down variously to the great increase of predatory gulls, to the menace of waste oil released at sea by tankers, and (less than formerly) to direct predation by man. Certainly auks, which swim on the surface of the sea more often than they fly over it, suffer most damage from floating oil; thousands are killed in this way every year. In the same period of the decrease of the auks (in the last hundred years) some sea-birds have greatly increased: e.g. gulls and fulmars, which spend more time flying than swimming—and their increase is believed to be due to increased food supplies, especially the vast tonnage of fish offal which is thrown hourly into the sea from the world fleets of modern fishing vessels. The auks are not scavengers; they live on small live fish and plankton and do not take advantage of the throw-out and guttings of trawlers and smacks. And while there is no sign that the supply of small fish and plankton is less than it used to be, changes in the distribution of this food of the auks may have occurred with the amelioration of the climate in the North Atlantic, and the gradual retreat of the ice-cap which has been noticed and measured recently. The auks may be moving north to summer feeding and breeding-grounds abandoned on the last advance of the ice. The increase of the gulls which prey on them, and on their eggs and chicks, may assist this drift northwards.

It will be an advantage, in avoiding the attacks of gulls, for the razorbill to resort more and more to the protection of holes. Many razorbills take possession of puffin and rabbit holes near the cliff edge at Skomer, laying the egg not at the end of the burrow but near the entrance. In theory more and more razorbills ought to resort to holes because of the greater rearing success in these hiding-places—always provided sufficient sites are available, which appears to be the case at present in the diminishing auk colonies. In this trend of the razorbill to use safer cover for breeding do we see the story of the puffin's migration from open to closed sites being re-enacted?

In his book, *Birds of the Grey Wind*, E. A. Armstrong describes the life of the tystie or black guillemot. This dumpy black and white auk with the red bill and legs lays one, two, or three eggs, which are protectively coloured although normally hidden in holes or shallow recesses. Is this auk also evolving towards hole-nesting? Seldom more than one chick is successfully reared from the clutch of two or three eggs. It is as if the adult found it difficult to manage more than one egg at a time; frequently the other egg or eggs are ignored and allowed to roll out of the nest. Yet this auk has two brood patches on the lower breast, not against the outside of each thigh, and so it is not a difficult feat physically to incubate two eggs. The razorbill, however, has to lean well over on her one egg when brooding. Gulls, like the tystie, overcome the difficulty by having separate brood-spots close together on the lower breast or belly, and by shuffling the eggs between the thighs until each is in its niche against the bare skin. Other birds which have large clutches have almost the whole of the belly clean of feathers during the incubation season.

Will the widely separated brood-spots of the razorbill and puffin eventually migrate to a more convenient central one between the thighs, now that they either lay one egg or rear only one chick from more than one egg? It might have been an excuse to say that the puffin and razorbill, using crevices and narrow burrows, had not the space to stand upright on an egg between the thighs, like the incubating guillemot; so therefore it must have, we might argue, the brood-spot on the side, and, having one brood-spot on one side of course it ought to have one on the other—nature abhorring the asymmetrical. But the shearwater has only one brood-spot, well back between and behind the thighs, lays only one egg, and uses a burrow exactly the same size as that of the puffin, in which it also contrives to find room to climb on to the back of its mate. The puffin's egg is, however, larger than that of the shearwater.

The problem of the brood-spots remained to exercise my mind from time to time as I sat on many an afternoon in May in the tent in South Haven, while the puffins, having no such mental exercise to bother them, concentrated on the production of a chick from the egg which had also puzzled me. And soon a new crop of questions remained unanswered. I felt sure the puffin neither knew nor cared that its egg was faintly spotted, or had or had not been more colourful thousands of years ago; but did the puffin know what the egg contained? Did it *expect* to raise a chick from the egg? Or was it incubating the egg quite blindly from an innate desire to press a smooth round object against the bare patch above the thigh? And when, if ever, does the brooding bird first begin to communicate with its unborn chick? The female mammal carries within her body her unborn child, which has developed from a fertilized ovum, for the length of the gestation period, in the latter stages of which she is well aware of its presence by its lusty movements in the womb; she is in com-



R. M. Lockley

The egg

R. M. Lockley

Grassholm, a puffin Pompeii

munication with it and she prepares a nest, burrow, lair, form, cradle, or other retreat for the delivery of this lively creation of her own flesh and blood. The fertilized ovum of the hen develops pre-natally in the same way, but while the mammal experiences this joy and pain of pre- and post-natal motherhood to the full in the movements of the soft flexible foetus, the undeveloped embryo in the oviduct of the bird is covered with a hard unyielding shell just before the egg is laid, and afterwards the hen has to deal with a silent and apparently lifeless oval object that shows no outward response whatsoever to the care bestowed upon it.

We ought to be less surprised then when we find the hen deserting her egg because the instinctive behaviour pattern of laying and incubation is interrupted by inquisitive human beings. Experiments have shown that some birds do not recognize their own eggs when these are moved a few feet away: gulls will sit on the empty nest or incubate balls, tobacco boxes, the eggs of other birds, and other round objects substituted for their eggs, even when these are placed in full view on the ground near them. They recognize the *nest* first, and will follow the nest if it is moved from the eggs by degrees, a few feet at a time, for a distance of many yards. What sort of intelligence is this? The gull will, however, roll her own eggs back into the nest if they are placed fairly near; but shows a poor knowledge of numbers by accepting far more eggs than she can possibly incubate if these are placed in the nest. Not all birds behave so unintelligently: terns or sea-swallows will look for and discover their eggs if these are moved for short distances by man or by tide action, and will dig out eggs which have been buried by sandstorms.

Yet the terns which dig down and uncover their sand-hidden eggs are activated by no process of reasoning, say the students of animal behaviour: the frenzy to incubate being temporarily frustrated by the disappearance of the eggs, the terns release their energy in the familiar innate habit of digging a scrape in the sand, and because terns have an exact sense of geographical position, they naturally dig at the centre of their procreative activities, in the heart of their territory, that is, the site of the nest itself. The trick has been learned, not by a clever bird dealing with an individual situation, as it were, but accidentally by the species itself over many thousands of years of adaptation to sand movement, during which only those birds which saved their eggs from the sand in this manner reared progeny which survived them and carried the habit forward in time. So, because it was an advantageous habit, it became part of the fixed pattern, like the burrowing habit of the puffin.

It is time we returned to the subject of this book. But one unanswered question leads to another, and now we are wondering how the puffin is able to recognize its egg in the darkness of the burrow. By smell? By touch? We have tried the experiment of replacing its egg with the larger egg of a great black-backed gull, and the puffin has accepted and incubated the strange egg—rather too large for its tiny brood patch. It did not object to the smell of the gull's egg, but perhaps puffins have no sense of smell—I do not know. Another experiment I made was to move a puffin's egg a little way down the burrow towards the entrance and tuck it into the wall of the passage, so that the owners brushed against it in passing; but they made no attempt to roll it from its new niche and get it back into the empty nest—they ignored it, and it remained quite cold for two days, until I returned it to the nest. So it is always the *nest* which is the centre-piece or key to the procreation pattern, and any change may be quite beyond the limited powers of adaptation (a process of learning, or intelligence) which is possessed in more or less degree by each bird. If the egg is moved or lost the bird may not attempt to look for it; it may give up nesting at once, and never lay again that year. This is what happens at least with some sea-birds, such as the puffin, fulmar, storm-petrel, and shearwater when the egg is taken away. The guillemot will lay again, and so will the gull; gulls in fact will go on laying up to fifteen eggs if each one is removed as fast as it is laid. I cannot help feeling that gulls, like hens, are stupid creatures. But then is the puffin more canny—not to be fooled into continuous egg production, you might infer? No such process of reasoning can be granted to the puffin.

Our experiments and observations show that the puffin has only a limited understanding of what it is doing with its egg. It is unable to retrieve the egg if this is only a few feet from the familiar nesting-chamber, and therefore it is no more able to recognize its own egg than is the gull. Again, although tame enough above ground, the puffin is extremely timid when its burrow is opened and the nesting recess exposed; if it can escape then it will not stay and defend its egg, as some other species will, e.g. the eider and other ducks, and the domestic hen. It will only fight when cornered. Nor will it attempt injury-feigning tricks to distract the attention of predators, as plovers and skuas do. Yet we may reflect that it is not really necessary for the puffin to recognize its own egg as such: normally the egg cannot roll away or be displaced in that dark cul-de-sac of the nesting burrow—it is always there when the puffin goes to earth. The breeding behaviour is a chain of instinctive actions, each released by its predecessor; only if the egg is removed is the chain broken—then the brooding bird becomes gradually aware that it has nothing to incubate, and to that extent it may be said to be conscious (of the loss) of the egg. We may also reflect that injury-feigning is not a useful behaviour for a species nesting underground, for normally the puffin has no large enemies, capable of entering the burrow, which it would need to draw away in order to protect the underground nest. It deals effectively with the occasional competitors for the burrow as a nesting site—rabbit, shearwater, or puffin—by striking and pinching with that formidable bill; if you have thrust your hand down an occupied burrow in an endeavour to corner a puffin you will know the strength of that bite!

We must leave the problem of egg recognition as far as we have dared to take it here, and return to the question of chick recognition and where this may begin. It is now believed that the unborn chick, nearing the term of incubation, may experience pleasure, or at least relief, in the actions of the adult turning the egg over at intervals during brooding; this causes gravitational movements of the embryo within the egg and so relieves pressures—man obtains the same relief when turning over in bed. The delicate way in which the brooding bird turns over the egg or eggs is evidence of her deep maternal care. She may even be sensitive to the muscular movements of the embryo within the shell as it responds (however automatically) to the turning ritual. When the chick first breaks through the membrane and begins to breathe and then to cheep, even perhaps before the shell is pipped, the hen bird may be aware of, and in communication with, the unhatched chick. No one who has watched the solicitous behaviour of the adult at hatching time can doubt this; and, indeed, recent studies of the behaviour of domestic chickens, before and after hatching, have proved this awareness. The tapping of the chick breaking the shell with the egg-tooth is heard by the brooding parent, who may respond with low soothing calls and with fondling movements of bill or breast. Thus the first impressions of the chick are those of the voice and movements of its parent, and these are indelibly imprinted upon the blank sheet of the new-born brain. Particularly is this so in those species where the chick is born with a thick coat of down and is active from birth, as in the puffin and the domestic chicks, where the brain development is further advanced than in the chicks of species which are born naked and nearly helpless, as for instance the passerines and the pelicans.

To recapitulate. Although Cula never properly saw her egg, she knew where to find it and, impelled by the frenzy of motherhood which is innate in the female of nearly every species, she warmed it, and we are entitled to suppose that she was not altogether insensitive of the joys of the maternal state. When the chick hatched, perhaps she replied with loving grunts to the squeals of the downy black object as it struggled to free itself, tenderly lifting her breast so that it would have room to thrust aside the stained white cap of its shell.

* * * * *

It is late May. Above the puffinry the bluebells drift in mauve sheets, dominating the ground where the bracken, lately uncurling its croziers, will soon hide the grassy nests of the gulls. Rich bouquets of the red campion, which grows thick-stemmed and luxuriantly in the salt air, sprout from moist hollows beside basalt outcrops perennially yellow and grey with lichens.

Activity on land in the giant puffinries now seems to be divided as follows. From dawn to ten hours (G.M.T.): one of the pair incubating, the other at sea, presumably feeding, few or none standing about the cliffs. From ten to about fourteen hours: an increase in the number of birds on the sea below the breeding-cliffs, and first groups assemble on land; these groups include individuals tired of incubation who come out of the burrows and leave the egg to cool for an hour or so, even several hours. From fourteen to twenty hours there is maximum activity on land and joy-flighting over the burrows. Gradually the social gathering disperses until before midnight all puffins are underground or gone to sea.

On 30th May the first bird to carry fish to land was seen. It dived into a burrow far from our tent. Its chick, to be hatched at that date, must have come from an egg laid not later than 20th April, a week earlier than the commencement of general laying on the Pembrokeshire islands.

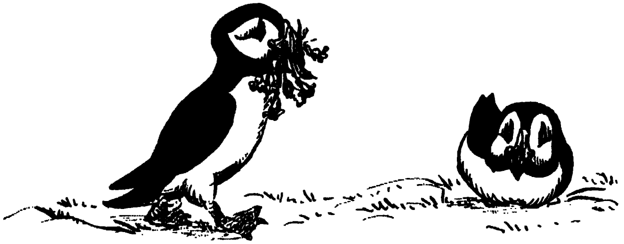
On this day I tried a small clapnet in order to catch and ring some of the neighbours of Frater and his wife. This net was a simple circle of wire and string netting hinged across the diameter so that when set only half the circle was visible. Almost as soon as I had set it and retreated into the tent Frater marched up to it inquisitively and began pulling and prying at the string, which no doubt he thought would make excellent material for toying with. I hissed and sang and clapped at him, but he was enjoying himself too much to notice or be alarmed. When his meddling sprung the net, with himself safely outside it, he flew away in astonishment.

It was six o'clock in the afternoon, and the assembly was gathering strength. I reset the trap. But no other puffin came to the net.

Half an hour later Frater alighted. He approached cautiously and gave the loose string another sharp tug, and set the net flying over, missing him by half an inch. This taught him to be afraid of it, and afterwards he kept clear of the contraption, for so long avoiding even his own burrow that I was compelled to withdraw the clapnet without catching a single puffin.

Its disappearance reassured him, and an hour later he was back on the familiar lawn in front of his home, dozing with eyes half shut, uneasily; this time for a change he was standing upright but with the bill in the usual position behind the scapulars of the left wing. Sometimes puffins rested like this, standing, instead of sitting. It was but a half-sleep, a day-dream, the eye never closing for more than a second's duration.

At 7.30 p.m. he was carrying nesting material into the burrow—green vegetation and dead grass. Other puffins were doing the same. On one occasion he walked with gay springy steps about twelve yards to a clump of sea-campion and gathered a beakful, including some of the white blossom. If only he comes near enough on the way home, I thought, I will have a fine colour picture—that white bouquet in the red bill! Alas, he almost at once dropped the beakful and, as if suddenly remembering how far he was from home, hurried back with mincing paddling walk



over the rough ground. He was diverted *en route* by the sight of neighbours billing, ran up to them and tried to join in. They stopped, gaped at him; he gaped back, stepping sideways. He picked up a lump of earth and walked back the last few steps to the front door.

Presently Cula emerged, turned round, evacuated a goodly pellet clear of the doorstep, and quivered her bill at Frater. He, eager to nuzzle her, dropped the lump of earth and thrust his bill towards her.

With the waywardness of a woman she was suddenly more interested in a stray piece of campion. She picked this up, and as she half turned she dropped it, as I believe accidentally, on his back. He turned his head to look at it, and ran a few steps as if frightened of the slight burden. Then he reached out and plucked it and held it in his bill.

She began to preen. Suddenly she flew away to sea, he instantly following her.

Ten minutes later they alighted together, as usual accurately at the doorway to the burrow. She went in as if to have a peep at the egg, and he followed. A few seconds later both emerged and sat close together in their fescue-poa-storksbill-pearlwort-buckshorn-plantain garden.

It was now possible to see that a change had taken place in their plumage. The glossy jet-black of early spring had been replaced by a milk-chocolate-brown tinge, especially in the centre of the back. The inner edges of the primaries or main wing-feathers were already whitish-brown, paler in Cula than in Frater. Frater's legs, vermilion in spring, were now ordinary red, but Cula's had become orange-, almost lemon-, coloured as they faded.

'How you have altered, my love!' Frater might have said, but of course he did not; he seldom addressed his wife vocally. He was still uxorious; one could see from his gestures towards her how disappointed he seemed to be that Cula was less ready than she had been in April to nuzzle bills.

He made a bow towards her as he got up and tentatively pecked her bill. She made no response when he pushed his bill against her white breast.

She was obviously a little weary of incubation. She was not taking any hints. When he went below for a spell she did not move immediately, except to cock her head quizzically when he made a groaning laugh from the depths of the incubation chamber.

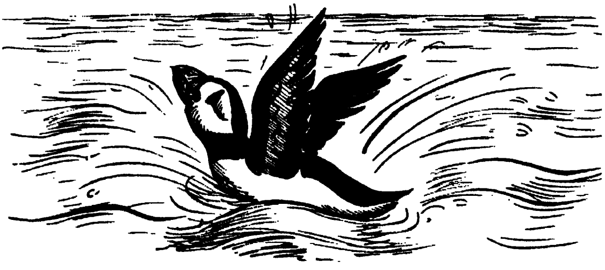
He did not reappear. Presently she ran lightly into the wind, fluttering upwards with moth-like flight, was airborne, and descended on a long plane down to the crowded bathing-pool of South Haven. I watched her through my binoculars from one of the holes in my tent. She alighted on the water, as puffins usually do, with a little dive of the head beneath the surface, not quite wholly submerging. (Sometimes puffins alight without submerging even the head, if there is a good headwind to make a slow touch-down.) She immediately started to bathe, with every appearance of enjoying herself. She lay first on one side and then the other, exposing her white breast as she beat the water with her wings and created a fine shower-bath which seemed to penetrate her ruffled plumage. Her action caused her tubby little body to revolve on the water like a slowly spinning top. Now and then she paused and shivered, like a farmyard duck on a pond.

This was the typical puffin bathing ritual after a spell of incubation below ground. In the burrow crawling insects and parasites and dirt and dust irritated the sitting bird, and may have been one of the factors driving it periodically to bathe.

There is no doubt that the puffin, underground and often far from the daylight, has a nice sense of time, which enables it to come out and enjoy the assembly at a fairly regular hour in the afternoon. Cula came off the egg and bathed every day at this moment.

My gaze was distracted by a bull Atlantic seal threshing the surface of the sea. He was killing a large pale-bellied brown-backed skate. The seal was tearing pieces of flesh from the white underside of the huge flatfish, and swallowing them jerkily, holding to the skate with its clawed foreflippers. Herring-gulls hovered above, ready to scavenge the titbits floating from this splendid meal which the lord of the bay had secured for himself. But the puffins, primary fishers like the seals, took no notice of this common event of their environment. The seals never molested the sea-birds.

Another seal—by her small size and slender neck a young cow—appeared alongside the first. They began to play together. Soon they left the disembowelled dying skate to sink slowly through the clear water, while they swam shoulder to shoulder around the western headland. The herring-gulls, which could not dive deep enough to grab the skate, wailed as if in disappointment.



R. T. Peterson

The social round (a Newfoundland colony)

CHAPTER IX

THE SOCIAL ROUND

La' laha, il Allah! Blithe as birds we flew along,
Laugh'd and quaff'd and stared about;
Wine and roses, mirth and song,
Were what most we cared about.
Fame we left for quacks to seek,
Gold was dust and dross for us,
While we lived from week to week
Boating down the Bosphorus!
La' laha, il Allah!

J. C. MANGAN.

SOME of the loveliest days, even now, at the beginning of June, were blank. Hardly a puffin could be seen in the morning and afternoon, and only a few would be flying between the land and the sea in the late evening. Yet there were young puffins born in the burrows, and one at least of each couple of parents must be in attendance upon the hatching egg or new-born chick.

It was difficult to account for these irregular blank days. I sat a little impatiently in the hide on these evenings. I knew that Frater or Cula, like the male or female of every other successful pair, was on duty underground. But his or her behaviour was quite wild and timid on these 'unsociable' days. He or she would alight from the sea, as usual upon the threshold of the right burrow, and look around as if amazed and fearful that there was not another puffin in sight. Discovering no comforting social welcome, the new arrival would plunge with all evidence of fear into the safety of the burrow. Or it might fly straight into its burrow from the sea.

There it might remain indefinitely, perhaps all night, with its mate. Or its mate might emerge instead, and giving that same surprised stare at the deserted playground, fly off without even turning around to relieve itself first. The waste matter, accumulated during the hours of incubation, might be voided as the bird rose into the air; although even during these 'off' days usually the first action of a puffin emerging from the darkness was to turn with the tail downhill and squirt the whitish or yellowish-green faeces well clear of the premises.

The contrast between an 'off' day and an 'on' day was astonishing. But by nothing that we could observe could we account adequately for these 'moods' of the puffins. They could no longer be related to food supplies and the movements of the shoals of thousands of the small fry of fish (sand-eels, mackerel, pollack, and herring), which, developing and growing rapidly in the spring, were now to be seen filling the little blue-green bays and natural rock harbours of the island on calm days. These wriggling shoals were always present near the islands from early June onwards, when the main flights of the puffins were absent. Nor was there any regularity about these off and on periods. Some mornings the flighting would begin at eight and continue all day, sometimes in calm sunlit weather, but perhaps rather more often in windy wet weather. There was this tendency, slight but noticeable, to reverse the tendency of spring ('on' days in fine weather) to 'on' days in rough weather, when a good breeze, accompanied often by rain, made the take-off and landing easier for these indifferent airmen. But it was no more than a tendency; on many rough days not a puffin stood about on land for more than a few seconds.

Another, but more explicable, tendency was for a full 'on' day to follow two or three 'off' days; and to that extent we could expect and forecast the next 'on' day.

'No puffins to-day?' I asked a lobster-fisherman one June morning as his boat came close to the Skomer shore. 'And none yesterday. I wonder why?'

'They do be afishing at sea, sir,' was the reply. 'Thee watch now, to-morrow they'll be as thick as thieves in the South Haven.'

'But there's plenty of sprats and sand-eels in the water all round you at the moment, Dicky. I wonder what the real explanation is?'

'I dunno, sir,' said old Dick, scratching his hoary head in genuine perplexity. 'But it do be the same in the spring when they first acomes to land. They do say there's a king of the puffins—'e gives orders to the rest puffins . . . they do say that, sir.'

'And who are *they* who say this?'

'Why, it do be an ole tale. We've a-always 'eard it so to be told in these parts, sir.'

* * * * *

Many June days were full, some blank, and others half and half. As the golden and blue hours drew near midsummer there were fewer evenings when no puffins paraded the green streets of the sea-front.

From my diary I take the main events recorded on an afternoon following a blank morning, as seen from the hide (all times in this diary and book are Greenwich mean time):

June 3rd, 1946. 13.30 hours. Entered the tent with only a few puffins on land and sea. No sign of Frater or Cula.

13.31. One puffin alighted with nine-inch-long white feather and goes to earth with it arranged neatly so that about four inches protrude each side of its bill.

13.40. Nine minutes elapse in which two arrived and one departed in the 250 burrows in easy view of the tent.

13.41. One arrived with a black feather six inches long and took it hurriedly below, as if it were a precious jewel.

13.42. Two left the same burrow.

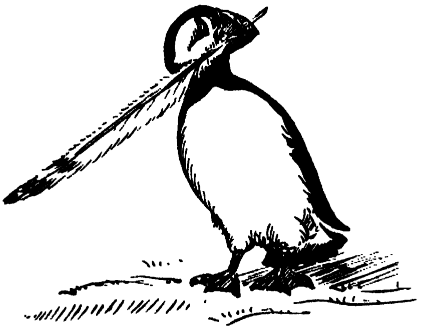
13.45. Counted about 800 on sea in sight from my tent.

13.47. About 600 rise from the bay and circle over the burrows, always flying slowly low over the land, and fast high over the sea. This division of the air into two regions or strata for slow and for fast traffic naturally helps to avoid collisions.

Watching some individuals I see that they make from one to three or four circuits before landing or dropping to the sea. This is a wonderfully exciting moment—witnessing a big flight rise with splashing noises from the water and wheel in a rushing cloud over the tent. The wings sing as they go past with the music of a mountain stream in spate. After settling on the land the majority take off again, as if uneasy as yet of conditions ashore.

13.50. None left on land.

14.01. Another carrying a large gull's feather lands and dives into a burrow with it. This is the third instance, in half an hour, of



feathering the nest—surely a curious amusement! A feather must be an amusement, it can have no value for the hatching egg or chick? These feathers are picked up on the sea, most often; evidently the gulls have started to moult.

14.10. None in sight on land. Large raft accumulating on the sea. Some circling. One lands plumb into its front doorway and vanishes. Most of them land with a fine accuracy, proving an exact sense of topographical position which, considering the vast number of holes, all superficially similar, is very nice to watch.

14.30. I leave the tent.

18.45. Have been back in tent for five minutes during which the colony has resumed full parade, after being locally disturbed by my crawling arrival. Frater is on view, leg ring and all. He strolls about, keeping roughly to a territory four feet square at present.

18.50. A fight. Frater goes six feet from home to referee. Clinching and unclinching of bills, neck-twisting, but no blows below the belt. At last Frater dashes at them (a breach of Queensberry rules?) and the fight is over. The opponents go to corners and sit down sulkily. Frater walks home with deliberate mincing steps and springy carriage, turns round completely (like a dog about to sit down), shoots a very small pellet of waste in the direction of the late combatants (looks like contempt but is probably reaction after excitement), and sits with his back to them, breast facing his own front door.

18.53. Frater, like every other puffin in view, watches each puffin near him as it alights or takes off, or does anything active. He cocks his head sideways to get a better view of each performance. (Query: If he cocks his head sideways he will see the performance with one eye only; then what is the eye on the other side of his head seeing? Does he 'think' with the outward turned eye only, the other eye being turned inwards, and temporarily unfocused?)

R. T. Peterson

The end of an affair

18.57. A herring-gull arrives, landing about ten yards from Frater. All the puffins within eight yards of the gull take off. Frater eyes the gull warily, standing almost on his toes, ready to fly too.

18.58. The gull walks through the colony, away from the tent, on the look-out for a puffin coming home with fish. Frater relaxes.

18.59. Frater wanders round restlessly, but never going far. He sits down, gets up, stares in all directions, approaches other puffins, walks away from them. He examines the front lawn. He tidies it up perfunctorily, plucking a loose blade here, picking up a stone there and carrying it for a while, then dropping it with a shake of the head. He does nothing in the busiest manner possible. He returns always to stand guard at his own front door.

19.05. A large rabbit runs past (there are several small ones grazing in the village streets of the puffinry) and settles to nibble a succulent patch of grass near Frater. He makes a sudden rush at the animal, which jumps away, evidently frightened. Rabbits are definitely afraid of puffins.

19.15. At last Cula appears—the buxom female with the ring on the left leg and the split web. Frater at once bills her vigorously. Pushing past him she disposes of unwanted matter in the windy semicircle 'without the camp,' and takes off. He follows. I cannot keep him in view in the confusion of hundreds of other comings and goings, but have no doubt but that she has gone for her usual bathe.

19.30. They return, alighting on the lundasina lawn. There is a slight alarm from a low-flying gull. Both fly off, he altogether, she to alight ten yards away. She is surrounded by other puffins sitting or parading outside their homes. I watch her with a new interest because she appears to be in no hurry to get back to her own territory, as if she had determined to let the egg go hang for an hour and herself be out in the thick of the crowd for a spell. She gradually threads her way through the social throng, like a well-behaved married woman ignoring the tentative quizzings (which seem to be incipient invitations to rub bills) of presumed males. (She is, I think, quite a desirable looking bird; but I am prejudiced through my long acquaintance with her.)

19.33. She is home, on the threshold. But where is Frater? Cula looks about her with a puffin's roving eye. She sits down, turning to gaze at her immediate neighbours on her right, who are billing fondly, though frequently interrupted by outsiders.

19.35. Cula rises. The billing on her right is too much for her. She, too, takes a step in that direction. Four other spectators are closing in. Before she has left the lawn, not a yard from the portals of her home, the billing ceases—due to interference by other neighbours. She settles back, to bask on her own doorstep.

19.37. Frater arrives, parachuting on to the lawn. He immediately bills his wife, and she is a willing party this time, having perhaps been stimulated by the events next door. I think Cula recognized Frater even before his red legs touched the grass. Mate recognition at 10–20 feet is instantaneous, although all cock puffins are exactly alike, and all hens seem like peas in a pod, to human eyes, except for the varying shades of leg-colour.

After billing Frater cocked his head upwards rapidly. He seemed to become enamoured of this proceeding. He went on cocking his head so long that I had the feeling that he was telling his wife what he had been doing in the last seven minutes. And she, as if replying, as if acknowledging his tale and telling hers, cocked her head upwards often, though less frequently than he did.

20.00. The numbers of puffins in sight on land are dwindling.

20.10. Only one hundred present on the cliffs and none, as far as I can see in the twilight, on the sea in the haven.

20.20. Only two left. The others have been disappearing rapidly, probably about forty per cent going below and the rest flying to the sea. One or two have come up from below, looked round the emptying scene for a few seconds, and then either flown off to sea or, like Frater and Cula, gone back into the bedchamber.

20.30. No activity anywhere.

20.45. I crawl out of the tent and aim for bed too.

CHAPTER X

HATCHING TIME

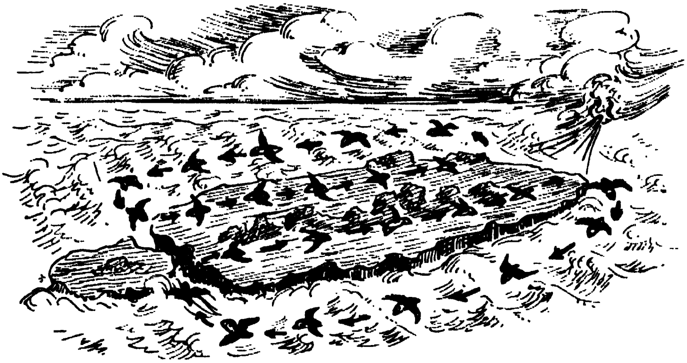
> Well then, I see there is no little bird
> Tender soever, but is Jove's own care.
>
> KEATS.

FOUR days later, on 7th June, we walked over the mauve carpet of flowering sandwort spurrey which almost completely covers the uninhabited fifty-acre island of Burhou, north of Alderney in the Channel Islands. Here puffins breed in such numbers as to darken the sky during their joy-flights.

A little low-lying granite island, much indented, its surface enlivened with natural rock castle and hillocks, Burhou once had a cottage, a garden, and a field or two. The cottage had been shelled, for target practice, by the Germans occupying Alderney a few years before. It was now a heap of stones in which storm-petrels were nesting. A few bluebells, some bracken, nettles, pennywort, and scurvy-grass grew near the ruin, but elsewhere the sandwort spurrey (*Spergularia marina*) dominated the island, providing a monotonous diet for the few rabbits of Burhou.

All that afternoon the puffins gathered in hundreds on the granite outcrops. When approached they reluctantly flew away or scuttled under the rock slabs, from which I and my friend, who was gathering material for his book on the birds of the Channel Islands, extracted many in order to ring them. Their behaviour was not quite like that of the puffins of Skomer and Skokholm, where the nature of the rock is less suitable for forming shelters for social parties of gossiping puffins. It seemed to us that these wind- and sand-covered towers, terraces, theatres, and natural palaces were used for this purpose of a refuge where puffins could concentrate for their meetings and parliaments safe from the murderous attentions of a number of great gulls which frequented the island; or at least more safely there than about the level open burrows where, if surprised, the puffin would have difficulty in either taking off or hiding quickly. But from the tops of the granite tors (as from the edges of the cliffs in Pembrokeshire) it could fly into space easily, or if beneath the stone roof it could run into the rocky galleries in which many pairs were nesting. Here it was quite safe, except from inquisitive ornithologists with long wire crooks.

As at Skomer it was evening by the time the Burhou puffin assembly was at its thickest, and probably a hundred thousand puffins were simultaneously on the wing, sweeping upwind in two parallel lines divided by the rocky backbone of the island, and swinging downwind over the sea. Endlessly the great twin ellipses swung round, with a roar of wings like the thunder of the traffic of a distant city.



Some individuals were carrying fish, and these would drop down accurately upon their burrow entrance in the mighty puffin slum beneath. But the majority were unburdened and seemed to be enjoying the mass flight; round and round they sailed, non-stop, as if triumphantly caught in the aesthetic pleasures of the merry-go-round at the fair. It was tremendously stimulating to the two human beings; how much more stimulating this company of thousands of whirling birds was to the puffins themselves was not hard to imagine. It was like a cup-tie football final in reverse: the hundred thousand souls making the double ellipse around the pitch were the performers, the men in the centre were the spectators.

As the sun set in a red veil over the English Channel the music of many wings softened. The evening joy-flight of Burhou had been the greatest we had ever witnessed over so small a slice of land. It triumphs in the memory yet.

We left Burhou as the rabbits came out and the puffins began to settle and go to ground after the usual standing about on the distinctive lawns of the springy sandwort spurrey.

But we were to come back in later summers.

* * * * *

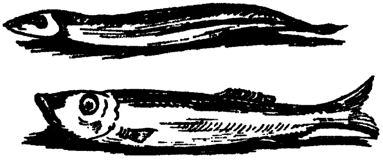
Frater and Cula were carrying very small fish by the 20th of June, when I returned to the hide at Skomer. Although I had not examined their new-born chick, I knew it would be like those I had seen in other summers: covered with long soot-black silky down, the centre of the breast and belly pure white, and with a short dagger-like black bill carrying at first the yellow egg-tooth with which it broke the shell. It would be nimble and able to walk from the moment it had dried after hatching. And it would require little or no brooding in that warm coat of down. The small brood-spots of the parents quickly grow over with down and feathers and are useless for warming purposes.

One mystery I did not solve, however, and that was how it received its first food from its parents. Probably, like the day-old domestic chicken, it required no food for the first two days, and until it had absorbed the last of the egg-yolk and become hungry enough to demand food in no uncertain manner. Its hunger-cry in fact was not unlike that of the domestic chick—a high-pitched 'chip-chip-chip!'

The adult puffins did not serve the chick with warm meals delivered from the crop in a semi-digested condition as do some sea-birds, such as the storm-petrel, the shearwater, and the fulmar; or even half digested and warmed in the gullet, like the gull and the gannet. It handed over the little fishes raw, and the chick soon learned to snatch and gobble them down.

When I entered the hide at 14.30 hours the assembly had begun, and those puffins disturbed by my arrival soon returned.

14.54. Cula comes out of her burrow, voids a thick stream of yellow waste which lands nearly a yard from her stance, and returns within, presumably to brood the baby chick, whose faint cheeping could be heard during her temporary absence. At the same time a pair appear at her neighbour's door, emerge into the sunlight, look round, and then first one and then the other go below again. They, and Cula, seem to be quite dissatisfied with the deserted condition of the sea-front.



15.07. Frater arrives with about ten small fish [1] arranged crosswise in his bill, heads or tails to one side or the other indifferently. As with his trophies of nesting material he appears proud of his load of sprats, and does not attempt to dispose of them quickly—not now that there are other puffins in sight to admire and reassure him. He stands at the front door, gazing in every direction by turns of the head. He stretches his wings very deliberately, arching and holding them high for a clear second before shaking them five times (this was the usual number of wing-shakes in this exercise of the puffin) before folding them.

15.14. He takes the fish indoors.

15.20. Cula appears and flies away.

15.50. Frater emerges. He walks six yards from the entrance and sits down near other puffins. This is something new. I had expected him to go to the sea for a bathe. But he seems quite at ease, so far from home. Is his territorial instinct waning as the cares of parenthood increase?

16.02. Frater watches an individual, more freshly coloured than himself, land with an awkward bump of the breast as if he were inexpert on land. He does not wear the appearance of an old house-stained adult. It seems to me that *he is an inexperienced adult*, for he walks about with an uncertain air. I say *he* because he has a big head, rich dark plumage, and bright red legs. But his bill has barely two ridges—one by no means prominent. He is young.

16.03. He looks around, paddles a few steps towards Frater, and takes a dig at the ground, picking up a scrap of campion and grass. Then he walks with absurdly cautious steps, placing each foot deliberately but very slowly and with a springing movement of the body, towards Frater, almost sidling up to the old cock in the brown abraded plumage.

16.04. He tries to bill Frater. (If he is a cock this is the first time I have seen deliberate billing between males; but the observer finds it impossible to distinguish between the sexes at more than a very short distance. Perhaps this young cock had the same difficulty—he wanted to find out the sex of this big bird near which he had alighted?) Frater shakes *his head impatiently, and* opens his wings and flies to the sea.

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[1] The fish food of puffins at Skomer and Skokholm was largely small fry of *Gadus* and *Clupea*, with some sand-eels (*Amnodytes lancea* and *lanceolatus*).

16.06. Newcomer wanders about *unsteadily, pecks at the turf,* suddenly runs to a small puffin, cocks his head upwards, and then succeeds in rubbing noses with her for a second or two. She breaks off and goes into a hole. Newcomer follows but has hardly gone out of sight before he leaps backwards—from what cause I cannot say. Did he receive a peck? Or was he surprised at the conditions of the married state—the smell, the dirty slovenly burrow? Certainly the stench of fish and guano has greatly increased in the puffinry now.

16.07. Newcomer sits down near the entrance and dozes for half a minute, his eyelids now closed, now blinking warily. It is almost as if he were pretending; but I think it is a genuine, if brief, impulse to rest.

16.08. Newcomer rises, goes to a female, who turns her back on him. He appears piqued. He marches up the hill inland, carrying a blade of dead grass. He goes on and on for about 35 yards until I can hold him in view from the tent no longer! I am convinced that he is a young unattached male, and that he has never bred. He had come back for the first time, at midsummer, and is now beginning that necessary process of familiarizing himself with the ground in readiness for next year. He may even find an adolescent female to go sweethearting with. His tentative approaches to adults are amusing and suggestive.

16.30. Interval.

18.15. Soon after my return to the hiding tent I see Frater alight four yards from his burrow, but instead of going home he walks to his new place six yards from his front door. While I am wondering why he has chosen this spot (which is near the cliff edge and more convenient for taking off into the sea-wind) he bills a female sitting there. When she rises to press against him I see that she is ringed—she is Cula! Now it seems almost certain that Frater spotted Cula from the air as he parachuted to earth, and therefore alighted near her, although pulled somewhat —about two yards—towards home. Another case of quick sight recognition in birds of uniform appearance!

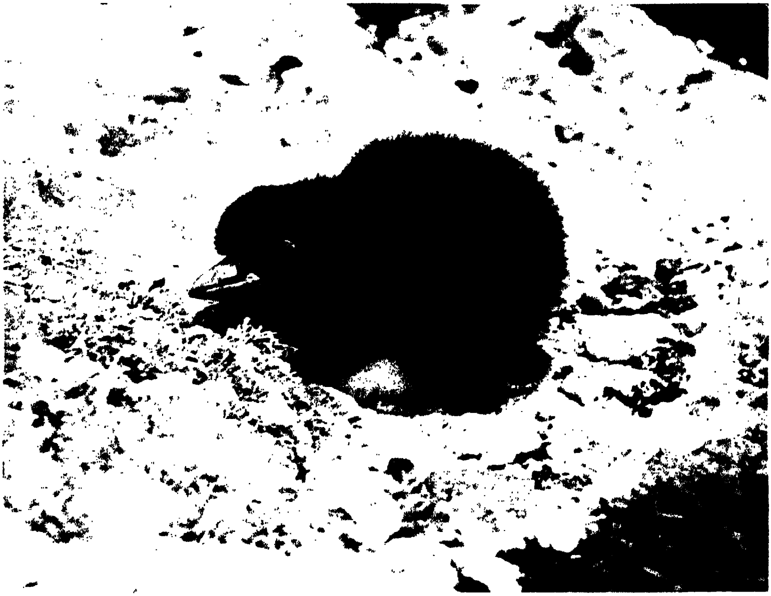
Frater nuzzles Cula so hard that she staggers back to the edge of the cliff. They sit side by side peacefully, bills uphill. Unless there is an onshore breeze most of the puffins seem to prefer sitting facing inland (uphill), as if it were more comfortable to rest with the big head well above the little body, which would not be the case if the bird faced down a steep slope.

18.23. Frater marches uphill on his own and goes into his house at last. Cula seems to have slipped over the edge of the cliff. I can only see the top of a puffin's head where I saw her last.

18.25. An unringed puffin suddenly rushes at the nape of a neighbour's neck, viciously tugs it, lets go suddenly, and runs away like a naughty child. (Comment on this behaviour would be dangerous!)

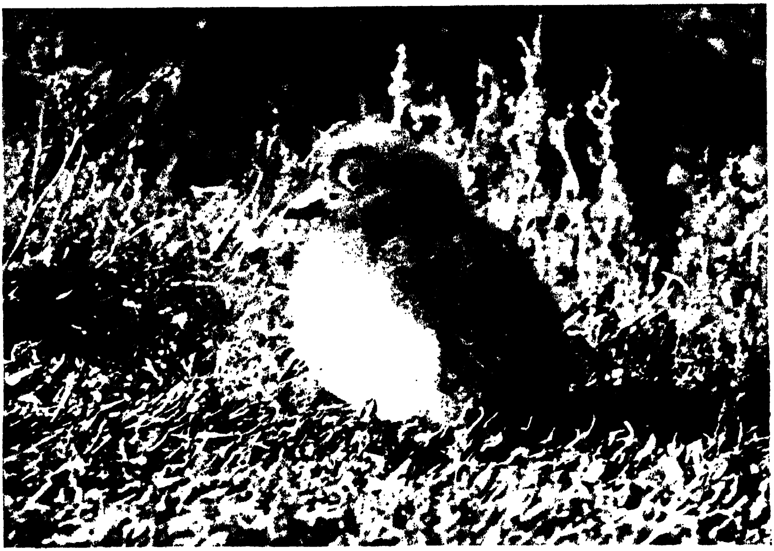
18.30. Frater reappears and stands on his lawn looking round as if for Cula. The chick, far inside the burrow, is silent. Evidently the feed of ten fishes it received at 15.07 hours, and possibly another meal in my absence, has satisfied it. Frater at least has evidently no intention of collecting more food for it to-day, and beyond an occasional visit he is content to idle.

18.31. Frater walks towards the bottom of the cliff where the head of Cula (?) is still visible. Before he reaches the spot he is suddenly attacked from behind by another male, possibly because the latter still feels some territorial jealousy? Or is this just an idle impulse, a discharge of surplus energy? It is not serious. They fall apart and gape warily at each other. Frater runs into the wind and drops back on his wings to his own lawn, where he sits down; for the moment he has been discouraged from crossing alien territory to visit Cula, or has forgotten his plan to do so. The attacking male is evidently charged with irrepressible energy. He remains in a curious and rather rare attitude in which Frater left him, his bill wide open, little round tongue thrust out, body erect and *head elevated*, tail cocked at a right angle to the back. In this rigid state he *walks* twice round a nearby puffin, whose sex I cannot even guess since it remains sitting, quite indifferent to this display of emotion. Usually this attitude, but with the head down, is struck while the bird is standing still, and is then a threat display. In this instance it appears to be a mixture of the threat *and* appeasement drives.



W. J. L. Sladen

The nestling about 48 hours old (with egg-tooth)



R. M. Lockley

The nestling, three weeks old

18.36. Much visiting of other burrows going on. Three birds disappear down one entrance.

18.40. Bill-rubbing continues, here and there. Sometimes the small-headed woman seems to initiate it. The satisfaction is mutual. Considering that coition is never indulged in now, this post-nuptial nose-nuzzling must be less sexual than simply the habitual expression of the bond, or attachment, of the connubial or wedded state. It has become a ritual. Eliot Howard has said that 'the oftener the female is stimulated the more susceptible she becomes: and the oftener his reaction overflows into posturing, since he too derives pleasure from it, the more *habitual* his posturing will become.' The long-continued nose-rubbing has the valuable function of preserving the love-bond between mated puffins in order that they may complete the duties mutually shared, of incubation and rearing. (Compare the behaviour of the human couple who, long after marriage has taken place, continue to exhibit mutual gestures of affection, thus stimulating and preserving the emotional bond so that the rearing of the family is assured.)

18.45. Great black-backed gull flying low disperses half the assembly, which takes off and forms a grand flight-circle; then most of the displaced puffins drop to earth like parachutists, on coming overhead for the first time.

19.00. Puffin with right foot cut off clean across the centre of the webs—an old healed wound—lands and aggressively attacks a neighbour for no apparent reason, and drives it away. Then picks up three lots of dead grass and flies to the sea with the burden—all these seem to be emotion-releasing actions quite without territorial or nesting functions.

19.05. Frater has returned. He peers often into the burrow now, as if wondering if it is bedtime. He does not object (rather surprisingly, but the territorial instinct is obviously weaker) to neighbours and strangers peering into the burrow too, or walking across his threshold on their way to pay visits. There is a general relaxation of privacy, in spite of occasional spitefulness and quarrelling.

19.35. Here is Cula, coming out of her burrow. (Strange that I did not see her enter it!) She bills Frater herself, they paddle side by side and enter the hole together. But when she turns round and walks out again, Frater is there behind her! He won't be tricked like that! He stands on guard. Cula moves forward a yard, coming close to another hen whom she suddenly pecks, as if to release her emotion (is it disgust?) over Frater's indifference to family cares. The other hen resists and in turn pecks vigorously at Cula. Cula is forced to flight. She makes a short circle in the air and drops beside Frater. The other hen, who has watched Cula's movements carefully with a cocked eye, now steps forward with mincing and, to the observer who has followed the incident closely, menacing steps, towards the couple. Cula, seeing her neighbour so aggressive, retreats to the far side of Frater. But Frater looks blandly indifferent.

The intrusive female actually sits on the edge of Cula's lawn, just inside the striped circle of the latrine deposits (*not* offensive for more than a few hours or longer than the sun and wind and rain and the absorbent grass permit), facing Frater and Cula.

19.38. Cula takes off and the uxorious Frater is only one wingbeat behind her.

19.39. The Intrusive Female has Cula's garden and the burrow all to herself. Will she have a peek at her neighbour's house and chick? It is a splendid opportunty. Rather to my disappointment the I.F. enters her own burrow close to the tent. I hear a very faint 'oom' which is preliminary, like the indrawn breath of the incautious radio announcer, to the characteristic rolling laugh: *Aar-haa-haa!* But of course I do not mean to infer that the laugh was sardonic and uttered by the I.F. in what may have been her satisfaction at putting Cula to flight. It just happened that for the first time I noticed the audible indrawing of breath *before* the first syllable. The growl following it came from a burrow almost under the tent, and may or may not have been uttered by the I.F. or her mate.

19.45. I am a little worried. No sign of Frater or Cula. It is getting dark in my hide. But their burrow remains unvisited. There are fewer puffins in the assembly. Some are still arriving but more are departing. The I.F. remains below, but other females take off; presumably their chicks are old enough to do without brooding at night.

19.50. About 50 in sight, some going in and then coming out of their burrows as if undecided whether to sleep at home or go to sea. Some stay in. Others fly away.

19.55. A passing gull helps some of them to decide. A few dive below, all others take off. None returns. There is not a puffin on the sea under the cliffs. Frater and Cula are spending the night away from home.

19.56. I discover that some poetaster has pinned a parody in a fold in the tent (see page vi of this book).

20.30. Two puffins which came out of their burrows a few minutes ago take off. All is quiet. Out of doors, as I crawl into the open, I can just see enough to read this diary—the last entries have been scribbled unevenly over the lines of the pages in the darkness of the tent.

It is midsummer, warm and with the promise of a fine day to-morrow. I intend to be in the hide by daybreak, in order to follow the sequence of this evening's exciting discoveries.

CHAPTER XI

THE NESTLING

When at home alone I sit
And am very tired of it,
I have just to shut my eyes
To go sailing through the skies—
To go sailing far away
To the pleasant Land of Play;
To the fairy land afar
Where the Little People are.

R. L. STEVENSON.

A LARK had begun to sing and I heard the wheatears clicking and clattering as I crossed the dew-wet bracken and grass. The sky was growing light in the east; but it was too dark to write accurately within the ruled lines of my pocket diary when I entered the hiding tent on the morning of 21st June 1946.

There was no movement of a single puffin above land or sea. A few rabbits were scuttering about.

02.30 hours. No puffins. No sign of Frater or Cula.

02.33. One puffin emerges from a distant burrow and flies seawards.

02.40. Seven more have departed seawards, averaging one per minute.

02.45. Two depart.

02.50. Three depart. One comes out, evacuates noisily, and goes to ground after two minutes of looking around warily.

03.00. Two more do the same, singly. A pair leave the same burrow together.

03.01. One departs. Another discharges waste matter and returns underground. These birds must be still incubating or nursing tender chicks.

03.02. Two more depart, singly.

03.03. One emerges, evacuates, pauses fearfully, and goes to ground after 90 seconds' hesitation.

03.04. An oystercatcher strolls among the burrows, feeding on slugs and probing for insects with its long red bill. It passes within a few inches of a puffin, which ignores it.

03.05. First two puffins arrive from seaward. One, with fish, goes to ground, the other flies back to the sea after failing to land properly.

03.08. Two more with fish come in. After this arrivals increased from one per minute to nearly two per minute by 05.00 hours. All, or nearly all, carried fish and went straight to earth.

04.00. About twenty puffins on the sea in South Haven.

04.01. Cula arrives with fish and goes like an arrow into her burrow. I cannot identify her until she emerges 14 minutes later.

04.15. It is Cula. Where is Frater? I too am hungry.

04.17. Cula flies away.

05.00. No sign of Frater. No assembly, no bill-rubbing, just one bird after another arriving with fish every 40–50 seconds, and one departing at same rate in the 250 holes (rough estimate) in near view from my hide.

(I go to breakfast and later spend most of this perfect day on a visit to Grassholm, returning to the hide in the evening.)

19.00. Assembly in full swing. Frater and Cula are on their lawn. He follows her about restlessly. When she flies off he quickly follows and overtakes her. They fly side by side far out over the haven.

19.25. They are back. Immediately on landing he bills her vigorously. Then they sit side by side for a few seconds, facing the same way. He nibbles her face: both have their tails cocked up.

19.30. I notice that Frater's white face has shaggy bluish patches. If I did not know that these are caused by the blood-swollen abdomens of numerous grass-ticks embedded in the skin I should suppose that the white was fading and the feathers moulting, as one observer has erroneously suggested. These parasites must cause a great deal of discomfort; they resist even the very sharp claws of the puffin. Fortunately they do not remain there very long; as soon as they are engorged, after a few days to one week of blood-sucking, they drop to earth again. Some puffin faces are quite grey by midsummer, due to a heavy infestation.

19.35. Cula goes to her new sitting-out place, near the cliff edge. *Frater follows her.*

20.00. *The usual visiting, mild* disputes, inquisitive interruptions of billing neighbours, playing with grass and feathers, and other social activities have amused me in the last half-hour. Now Frater and Cula fly to the sea together, and do not return.

* * * * *

To my regret this was the last day which I could spare for regular observation of Frater and Cula at Skomer that year. It was nearly time for me to relinquish command of the field survey of the island, which had been conducted for the West Wales Field Society.

On 22nd June, in order to make sure of the present position inside the Frater and Cula *ménage*, I dug down into their burrow and after a lot of exploratory work with a wire drew forth their chick. As I expected, it was a ball of rusty black down, with white breast, stumpy black beak, and beady milk-chocolate eyes. Probably it was four or five days old. It was anxious to get back to the darkness to which it was accustomed. When released it toddled away with firm steps into the depths of the burrow. I repaired the surface as far as I might by replacing the spadefuls of turf.

Next I opened six other burrows to check on the present state of incubation and rearing. Five still contained one soiled egg each, and of these one was already pipped and about to hatch. The sixth contained a chick about a fortnight old, just old enough in fact to wear a ring on its well-developed legs. Two adults, caught on the egg in separate burrows during this operation, were infested with the blood-swollen bodies of *Ioxodes uriae* (also known as *I. putus*), the grass-tick already mentioned, which gave a bluish tinge to the white plumage between the eye and the lower mandible.

It was during our last few days on Skomer that we noticed a strange-looking puffin in the South Haven burrows. It appeared to be in winter plumage. Stalking it patiently with the long bamboo and wire crook we succeeded in capturing the oddity.

It was an immature bird, probably born two years ago. It had no brood-spots. The bill was at the winter stage, the lower mandible strangely lopped off by comparison with that of the breeding bird. The first roll or ridge at the base of the bill was poorly developed, the rictal rosette or false lips dull, small, pale yellow. The eye flashings were there, almost normal, but the eye-rim was a dull flesh colour, not the usual scarlet. The face, although quite free of ticks (suggesting it had spent little time on land), was almost as grey as that of the juvenile in August. Its presence was a little puzzling: we have seen that non-breeding puffins in mature plumage visit the colony from June onwards. But we had rarely seen young birds in their winter or first-year plumage at the puffinry, and had never before managed to handle one. I would estimate that puffins in this plumage on land are in the proportion of roughly one in five thousand adults at midsummer. In the present state of our knowledge of its life cycle we do not know exactly how old the puffin is when it first breeds, certainly not before it is two years old and in its first mature plumage. The bill is then small and has only one, or one and a half, strong transverse ridges. These two-year-old non-breeders come to the colony at midsummer; but some non-breeders appear, by the growth of the transverse bill-ridges, to be older—possibly three or four years old, but these may be the two-year-old males.

However, one thing is clear, the yearlings (with their easily recognizable triangular bills) normally remain at sea for the whole of the second summer of their existence. The exceptions (like the one we had just caught) are so few that we may wonder if these are not really older birds, two years old at least, which have suffered from uneven or retarded development? Only extensive ringing—a difficult task—of young puffins can give us the required information.

* * * * *

The South Haven hiding tent was now in a deplorable state. It had been a rough summer. Frequently the wind had flattened the hide and I had had to re-erect and repair it. It was already a heap of sticks, canvas, and sacks by the end of June. I let it lie in its bed of budding ragwort and bracken on the edge of Frater's territory. On 7th July I left Skomer and did not return until after the August departure of the great host of 100,000 adult puffins and their progeny.

CHAPTER XII

OF FISHING AND FOOD

> You have curious things to eat,
> I am fed on proper meat;
> You must dwell beyond the foam,
> But I am safe and live at home.
>
> R. L. STEVENSON.

IN THE next summer, 1947, I took up the story where I left it in 1946, but this year during a holiday on the island of Skokholm. How eagerly did I resume my acquaintance with the puffins on the windy slopes above the red sandstone of Crab Bay, where I had last studied them seven years before! Here, because of their abundance, the place had been dubbed Puffintown, a name which it bears to this day in the annals of the island observatory.

This time, however, there was to be no inconvenience of flapping canvas tent and wet sacks. We would establish a permanent hide. Collecting some strong driftwood planks and posts, the cupboard door of some wrecked ship's cabin, some sheets of corrugated iron, a spade, crowbar, saw, hammer, and nails, we built a roomy permanent hide with wooden walls and louvered observation windows. Between us volunteer Mathews and I crowned the little house with a thick roof of turf above the waterproof iron sheets. A wooden bench was provided for two observers to sit in comparative comfort. This hide was completed on the last day of June 1947, and it has so far stood six years of gales and weather.

The puffins were wary of it for one day: 1st July was reserved to allow them to get used to it. By 2nd July they were sitting complacently all about the hut.

I set a clapnet to catch a new Frater and went within. The net was placed on the threshold of a burrow eight feet from the new hide. A female was trapped, a new Cula, whom I ringed on the left leg; but I failed to catch her mate in this burrow. He twice sprung the net without being caught in it and, as had Frater, he became so shy of it, and so did she, that I had to give up. Fortunately this male had a pronounced limp by which I could identify him.

The new Cula was a loving bird, fond of billing her mate. It was natural and convenient that I should call this pair Limp and Loving in my diary.

* * * * *

From dawn on the next day, 3rd July, I arranged a continuous watch with other observers. Alfred Schifferli of the Sempach Bird Observatory, Switzerland, was on duty from 03.45 to 06.40 hours. It was a misty morning. A full tide covered the brown weed which at low water made a glistening causeway across Crab Bay to the red reefs where the gulls loved to perch, isolated from the human inhabitants of the island.

The main plan of this dawn watch was to count the number of puffins arriving every five minutes with fish, so as to ascertain the peak periods of feeding the chick during the day. I had marked out a puffinry of some 1,326 square yards in extent which could be seen clearly from the hide, and this area was found by careful counting (squaring off sectionally—see page 92) to contain 534 occupied puffin holes (that is, burrows with puffin latrines or guano semicircles in front), or approximately one burrow to two and a half square yards. This was to be the area watched intensively, and every arrival thereon recorded.

During his watch Schifferli counted 339 arrivals of puffins carrying fish. My diary goes on:

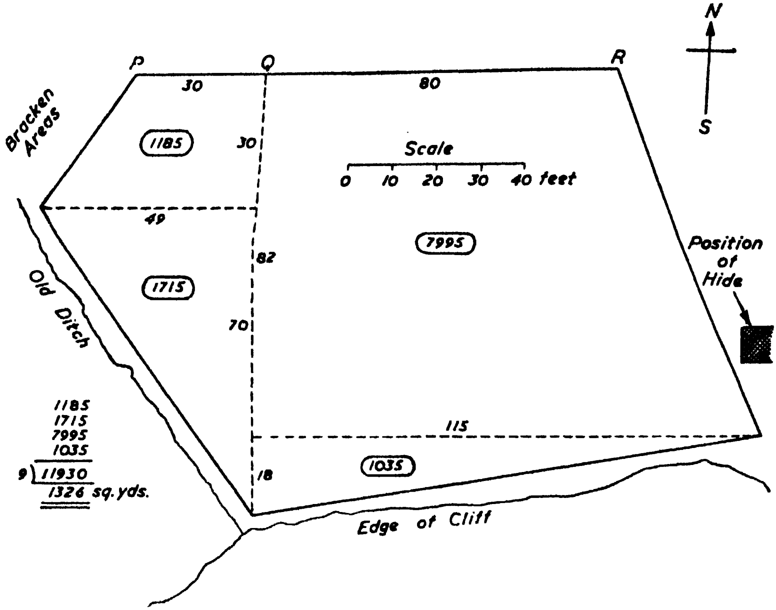
06.40. None sitting about idly. All arrivals carry fish and go straight into the burrows. A herring-gull is constantly on patrol, clumsily trying to intercept the arrivals. From the ground the gull observes carefully the flight of each loaded puffin near it, peering with lowered head and beak aggressively at the ready. It is a dirty-looking immature individual, a 'rogue' gull which has adopted this parasitical habit of snatching fish caught by others. It alights on a burrow too late—the owner is under the ground just a few inches in front of the gull.

06.45. In five minutes 3 puffins land with fish.

06.50. In five minutes 25 land with fish and one without.

06.55. In five minutes 19 land with fish.

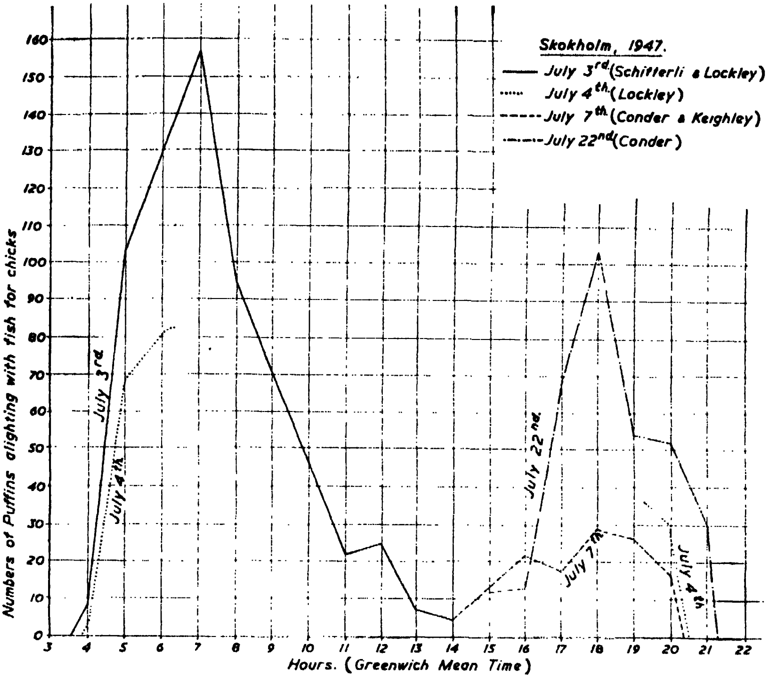
07.00. In five minutes 22 land with fish and 1 without. (For the rest of to-day's records of fish landings, see page 93.)



A puffinry at Crab Bay, Skokholm, July 1947. Approximate area containing 534 occupied puffin burrows.

07.15. Raining. 15 sitting idly outside, several landing without fish. Mostly silent. One growl about every ten minutes in the whole colony emphasizes this silence of the puffin—as far as can be heard from the hide. Birds remain underground to feed chick about 2 to 5 minutes. One or two preening. No bill-rubbing so early in the morning. Housework first is the rule. Nothing social. Just concentration, if it can be so called, on feeding the chick its breakfast.

07.20. Where are Limp and Loving? The adolescent rogue herring-gull watches the flight of an incoming puffin and, anticipating its descent to the burrows, adroitly collides with the loaded bird at the entrance to its hole. The puffin drops the fish and staggers away half walking, half fluttering; then sits up and ruefully watches the gull devour the scattered sprats. When the gull flies off the empty-beaked puffin walks towards its burrow as if still determined to visit its chick; but goes off to sea as the gull swoops towards it in chase of a second puffin returning to land with fish.



Number of puffins alighting with fish per hour in an area containing 534 occupied burrows (1,068 adult puffins).

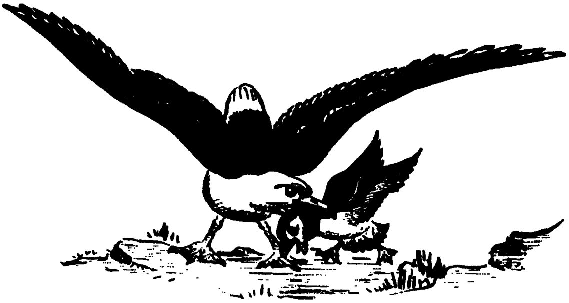
07.30. Gull has another successful collision, buffeting the unlucky puffin into the wrong hole while it gobbles the dropped fish. The dazed puffin dives below, but almost at once (realizing its error?) emerges and flies away. The gull calls noisily, as if triumphant—probably it is just complacent.

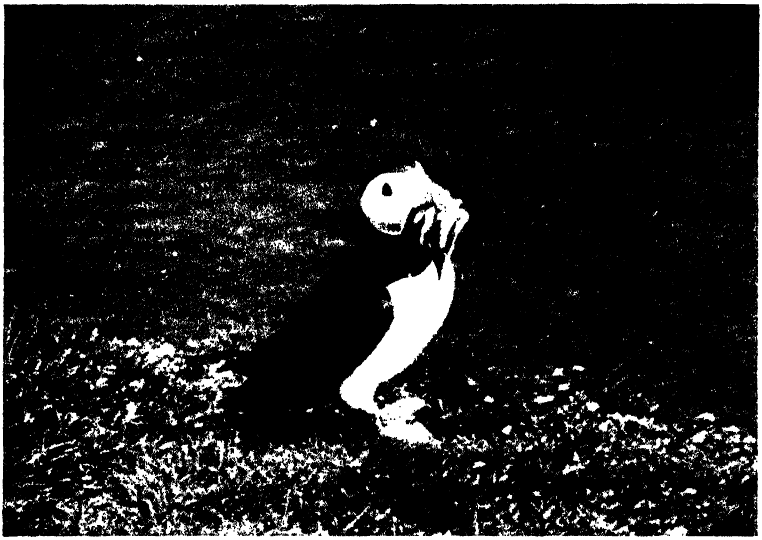
07.35. Rogue takes off on usual periodic flight round Crab Bay, alighting to continue its ambushes and robbery with violence elsewhere in the 500 burrows.

07.38. Two puffins come out of one hole where one entered with fish two minutes earlier. They, like the other puffins now, have their white breasts slightly soiled, evidently through rain-water running into the house and from contact with the excreta of the chick in the burrow. However, the chick is now learning to walk to near the entrance, and as it grows older it turns and stern first fires waste matter outwards, making a fresh semicircle upon the lawn, a half-ring much nearer to the mouth of the burrow than that made by the incubating adult. And, by the way, this greater, outside ring made by the adults is no longer very obvious; the adults are no longer brooding and therefore they use the old 'place without the camp' less often. But the lawn is well trodden and the walls of the entrance still rubbed bare with the traffic of the adults.

07.40. Rogue gull pursues one puffin down to the sea, forcing it to disgorge contents in its bill. Rogue devours fish on surface of the sea. It has made a very good breakfast so far! Now it indulges in a grand bathe.

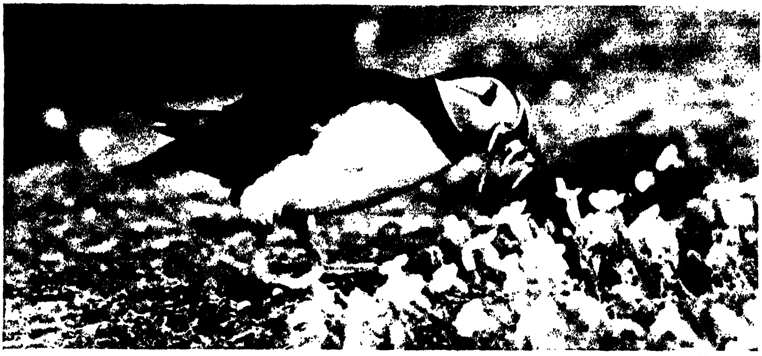
07.42. Great black-backed gull appears. Walks about among burrows, terrifying two puffins flying in with fish. They swerve in the air and go back to the sea. But G.B.B. does not attempt to rob them, as the rogue herring-gull did other puffins. It is looking for larger game. It peers into the burrows as if searching for something. It sits on top of one burrow and waits, now and then cocking its head and peering, as if ready to strike an emerging bird. Suddenly it leaps a foot and grabs a puffin which has come out of a burrow at that distance. It has the puffin by the neck and shakes it like a dog with a rat. I can hear the puffin growling and see that it tries to wriggle to face the gull. It is all over for the puffin, I say to myself (for I have seen many such a murder take place at the beak of this great gull), but I do not interfere; not only would I be unsuccessful at that distance, but I long ago resigned myself to be spectator only. I watch reluctantly the horrid slaughter begin—but to my surprise the puffin jerks itself free. It flies away. This is a rare escape—I have not often seen it before.





W. J. L. Sladen

Large sand eels for the well-grown chick



G. R. Shannon

Little fishes for the nestling

Almost immediately the great gull makes a swift run to another burrow and stabs its beak into the entrance. Its head and shoulders are for a second hidden underground. Then it backs out, dragging a black-and-white object—a young puffin. The poor child has probably been caught at a disadvantage as it backed to the entrance of its burrow to relieve itself after a heavy breakfast. The gull beats it on the ground thrice, then swallows it whole, and flies away to bathe in the sea below.

07.44. A puffin alights and sits down unconcerned near the scene of the recent disaster (which it may not have witnessed), as if desirous of resting. It gets up presently and peers first into one and then into another burrow. It returns to sit in the first position. What does this inquisitiveness mean? Having fed its chick (if it has) is it just plumb tired after a night's fishing? Is it hoping to find its mate? Is it a non-breeding bird seeking company? Any guess will do—for the moment.

07.50. Raining heavily. The hide is quite waterproof. A lull in the arrivals and departures. Rogue herring-gull sits preening on a rock outcrop, evidently not hungry.

07.51. I wrote the above too soon. Rogue spots puffin alighting with fish (two very large sprats) near my hide, and dashes at the fisherman with such agility that the puffin drops its load. As the two sprats roll downhill the rogue catches and swallows them.

07.55. Puffin lands with fish near hide. It is Loving herself. She looks nervously at rogue gull and flies off. She lands again. She hesitates. The rogue has been watching her all the time and now makes an adroit swoop. Both birds tumble over the cliff together as Loving tries to escape with the fish. I am unable to report the result as a consequence.

08.00. Schifferli arrives. I depart.

11.30. I take over from Schifferli. Fish arrivals are subsiding; less than one per minute over the 500 burrows. Early morning is evidently a peak period (see graph on page 93). Only about 30 puffins in view, coming or going, but a small raft on the sea. One puffin has a beakful of dead grass. I try to count the fish in another's bill; at least ten tails are in view. I decide to scare rogue gull next time he attacks a puffin and try to get the fish before the gull does.

11.40. Rogue gull swoops at arriving fisherman. I scream and thump wooden walls of the hut with unexpected success. Gull flies off and two puffins drop fish near by, which lie scattered so that I cannot count them as two separate loads. But I gather up a total of 44 small fish! Chiefly minnow-size young herrings—at least that is what they look like. There is only one sand-eel. An average of 22 each (but on another occasion I have counted 28 fish dropped by a single puffin).

11.42. Back in the hut I reflect on the mechanism which enables a puffin to hold over 20 fish in the bill at once. I think it is probably easy—in fact it must be, or the puffin would not do so. Selous was much puzzled by this problem, but does not altogether hit on the solution in his curiously naïve account: 'I have sometimes wondered if the fish which the puffin catches so deftly, and then carries home, a dozen at a time, are paralysed at the sight of it (the beak). If a shoal of sand-eels fainted, and lay strewed about the bottom of the sea, it could then be easy for their enemy to pick them up one after the other, pack them securely, and get a firm grip on all of them before they began to revive and wriggle. At least it ought to be easier; but how the bird chases and catches each in succession without losing those it has already caught and which lie in a row across its beak, it is not so easy to see. I have sometimes, I believe, made out a dozen at the least—all sand-eels—closely wedged together along the cleft of the mandibles, their heads and tails hanging down on either side of the lower one. Perhaps, however, the difficulty is not so great as it seems to be—of understanding it, of course, I mean; it is no doubt easy enough for the birds to do. My theory, at any rate, of its *modus operandi* is this. The first sand-eel is, no doubt, passed to the base of the mandibles, and being firmly wedged against the membrane that unites them, I suppose that they are finally closed upon it. Were they opened again, at all widely, to catch the next and subsequent ones, there would be a danger of as many as were already there either escaping by their own efforts or being floated out owing to the pressure of the water. But the beak of the puffin, though broad and leaf-like in its shape, is sharply tipped, and by opening it but a little, and pressing the fish against the bottom, the bird could no doubt pinch up the skin so as to get a secure hold of it. The various little tactile movements of the mandibles upon the fish, by which the latter would be first grasped between and then passed carefully down them to lie against the one last caught, can be pretty well imagined, and they could be very effectively aided by the rubbing and pressing of it on either side, against the sand, rocks, stones, etc., of the bottom. It must be remembered too that the mandibles open like a scissors, so as to be wider apart at the tips than at the base, which would diminish the difficulty; and, moreover, each fish is so deeply indented by the sharp, cutting blades—which, however, do not seem to pierce the skin—that, although alive—reflecting possibly the beauty of maternal affection—they would be likely to 'cleave to their mould' like putty, for a little while after the pressure were relaxed.'

My own version of the fish-gathering was written before I searched Selous's books for such references, and I give it straight from my note-book: 'The first fish is caught, nipped so hard by the tip of that sharp bill that it is instantly killed by this pressure applied in its vital centre. It is then jerked back over the tongue into the fleshy orange flanges of the rictal rosette. The next fish is caught with another snap of the bill, which is hinged open just wide enough to grasp the sprat while the first fish remains wedged in the barely opened proximal end of the mouth. As the fish accumulate they cannot all be held close to the proximal end of the mandibles; but the roof of the mouth, under the upper mandible, is furnished with a double row of backward projecting spines or serrations which must materially help to keep the fish in position. Moreover the curious thickened finger-like tongue must be useful, when the bill is opened to gather the last of the load of little fishes, to press the fish already caught against these spines. The last fish usually remains where first caught, at the distal point of the bill. Not that the puffin is infallible in holding this bulky catch; often it drops a sprat or a sand-eel here and there as it comes into the burrows—it is probably through picking up these stray fish that herring- and lesser black-backed gulls first acquire rogue habits. In Faroe puffinries terns (sea-swallows) pick up these fallen fish.'

11.45. Rogue gull returns and walks about in puffinry, which had become deserted because of my sudden sally. It examines the spot where the fish had fallen—evidently remembering the incident. I flick a couple of the sprats through the louver windows. Impudently the rogue devours them. I complain to the rogue aloud: 'Out upon you, thief and vagabond, I want to study Limp and Loving! Where in the name of the king of the puffins are they?' The rogue flies off with a sardonic laugh.

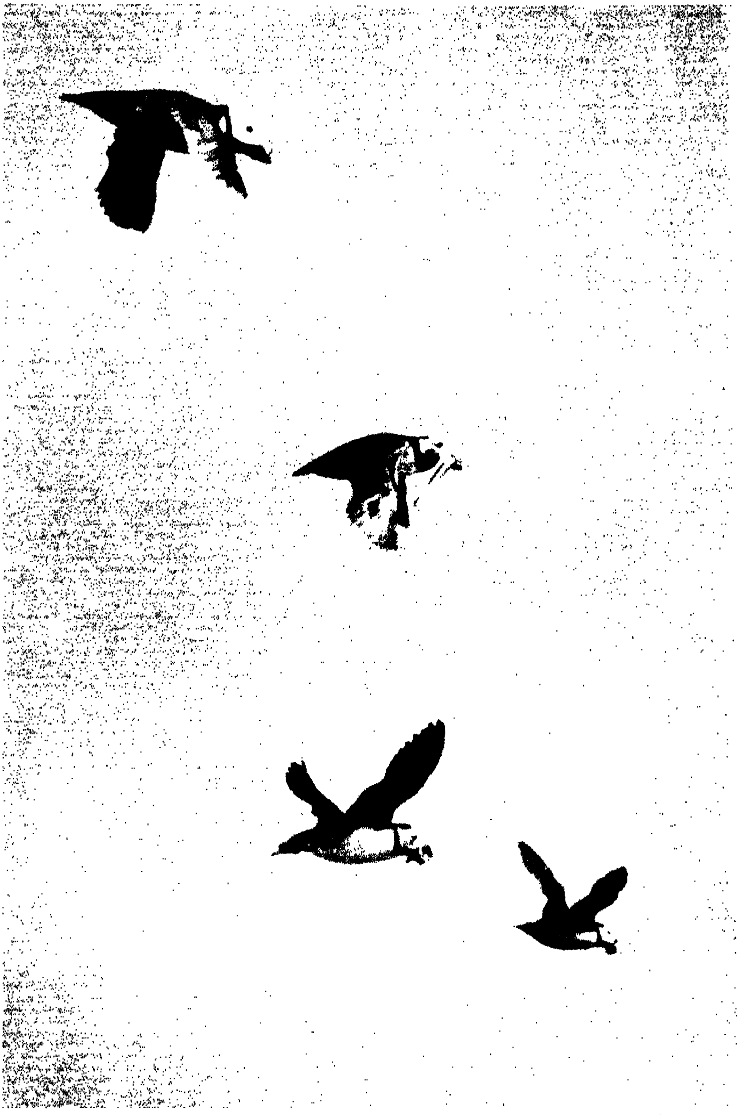
11.46. A rock-pipit is hunting for insects close to the hide. It picks up fragments of a sprat and flies off. It returns almost at once to look for more. I flick the smallest of the fish, about 1¼ inches long, towards it. The pipit seizes it, beats it on the bare earth, and carries it off (I have seen these pipits feed one of their chicks on a 2-inch sprat in the Channel Islands).

11.48. Limp arrives with fish. Limps into burrow after a glance round.

11.50. Limp emerges and sits near mouth of burrow just as another puffin alights near. Newcomer walks into doorway of Limp's burrow and peers in. Limp stares for a moment, then rushes at him. Limp goes into burrow himself, followed to the doorway by Newcomer, who peers in cautiously, then backs out, and walks about fifteen yards east. Surely N. is another unattached, non-breeding midsummer visitant?

11.51. Newcomer encounters a solitary puffin sitting outside a burrow. N. tries to nibble Solitary's face. She, or he, refuses, turning away head. N. appears to spin a yarn; that is, he chucks up his head repeatedly in the appeasing gesture. N. wanders off and enters a burrow, successfully this time.

11.54. More birds in view, about a dozen puffins near me. Five are preening. One (N.?) is ejected forcibly from burrow entered by N. Ejector's head alone seen, and disappears below at once.



N. Tinbergen

The fishermen come home from sea

11.55. Ejected puffin (I think it must be N.) picks up some grass, and walks around, anxious to make love to someone. He returns to Solitary, walks round her. She, or he, points bill always at N., warily keeping him in view.

11.58. Another newcomer (A.N.) alights and begins to excavate a blind hole about six inches deep. N. at once becomes interested and trots up to A.N.'s posterior. N. nibbles A.N.'s tail. A.N. turns half round and nibbles N.'s bill for one second. Suddenly a smallish puffin standing outside a neighbouring burrow runs up and bills A.N. for three seconds, quite cutting out N. A.N. breaks off nuzzling and turns to contemplate the site of the excavation. N. follows Smallish for a short stroll while A.N. gets back to work, digging as happily and as perfunctorily as a child on the sands. Smallish, two feet away, ignoring N., pulls up campion viciously. Is this a displacement reaction, in place of threat, on the part of Smallish, who appears so hostile towards N.? Smallish trots back to A.N. and nibbles A.N.'s tail exactly as N. did. A.N. turns and bills Smallish stoutly, sideways at first, then full front. (When billing, puffins always keep the bill on one side of their partner's face throughout the ceremony.) N., apparently at a loss for employment, now steps into the hole which A.N. had been digging, and examines it critically. It stimulates him (as he is conveniently in the bending position) to pass a small pellet of unwanted matter rearwards downhill. This dog-like action may or may not be significant. It looks rather like contempt!

12.00. Limp appears. General alarm as a great gull swoops overhead. Exeunt all puffins. The great gull has a squealing razorbill chick in its red-smeared bill, and is mobbed by two adult herring-gulls. Great gull alights on rocks near water and swallows chick whole after two or three beatings on rock, then sits quietly digesting horrid meal (probably delicious to gull palate) while herring-gulls swoop repeatedly, nearly touching the great gull. The herring-gulls no doubt have some chicks of their own just here.

12.05. Puffins trickling back from the wheeling flight overhead. Limp seems to be in a lazy mood. Perhaps his game leg is troubling him? Although it does not appear to be swollen he walks like a man with a thorn in the sole of the foot. He sits watching a bright-plumaged adult (Newcomer?) toying with a tuft of grass which N. carries proudly about. N. drops this soon in favour of a lump of rooty earth thrown out by the excavations of A.N., who is back on the job of navvying. N. grabs the rooty earth and trots about rapidly, neighbours watching him, and some pursuing him like curious children. N. won't let them come too near. But he is clumsy and frequently drops his beakload, only to pick it up again. It is rapidly disintegrating, the grass tuft has gone and bits of root and earth fall off. At last he tires of the game, and, emulating the majority, he squats quietly.

12.09. About 100 present in the marked area of 500 burrows. General laziness and sitting about. No fish landed for the last quarter of an hour.

12.10. Great black-backed gull scares off all but 7 puffins. They return quickly.

12.15. Rogue herring-gull lands near hut, as if it remembered fish dropped by puffin and grabbed by me. I flick remainder of fish through louverboards. Gull devours these feverishly, though apparently unaware and unsuspicious of the source of this manna. It is thoroughly greedy, and gobbles frantically—probably afraid of competition from other gulls—swallowing lumps of earth and dirt which it accidentally snatches up with the fish.

12.20. Two male puffins fighting, beaks open about one inch at tip each time they break off and, so to speak, go to corners. Aggressor turns his head sideways first in order to snatch a grip of the upright bill of the other. This grip enables him to force the other backwards easily, especially as Agg. is uphill of Other. They wriggle and push and flutter wings. The excitement as usual draws a crowd, in which Limp joins. The spectators jostle round the combatants, leaning forward almost on tiptoe, with outstretched bills, ready, if not to give advice, then certainly to take part, like children anxious not to miss any excitement.

12.21. The fight subsides, the opponents standing with yellow gapes opened in stiff threatening posture.

12.25. Loving arrives, I think without fish this time, but she flies too fast for me to be sure, straight into her burrow; I caught only a glimpse of her ring. Has she been away since 07.55? Limp goes to burrow mouth, gazes in, and then sits down outside.

12.27. Loving emerges, her white blouse a little stained. She preens, and is so close to me that I can see the large oil-nipple when she raises the feathers above her tail and daubs her bill and nape with invisible grease.

12.28. Puffins walk with a gait normally of little body movement, head tucked back with chin on breast, and legs a bit bandy. But when stimulated by a mate or neighbour they walk with exaggerated sailorly roll, each step accompanied with a lifting or hunching of the body, thus raising and lowering their height by about an inch; the head is then held with bill clear of breast.

12.50. All rather sleepy again and sitting down much. Suddenly alarmed when two great gulls settle on slope above puffinry, and one gulls puts its head down and says deeply: 'Ow! Ow!' with bill pointed vertically at ground. It then throws bill skywards and bellows: 'Ee-ow, ee-ow-ow-ow-ow!' It repeats this performance, which many puffins find too much for their nerves, and they leave. Great gulls continue disturbance by flying low over the puffinry.

12.55. New puffin arrives from sea with whip of seaweed about fifteen inches long. Adds grass stems and other scraps to this prize held in its bill. Walks twenty yards across slope, picking here and there and still holding seaweed, and disappears over sloping edge of cliff. Its legs were coral-coloured, those of Limp are wagon-red, those of Loving are faded to lemon.

12.56. No fish coming in lately. But many landing without fish. The promenade is filling up. About 130 adults on view in region of 500 odd burrows.

12.58. A lesser black-backed gull pitches in puffinry, but leaves almost at once. An apparently purposeless visit. (Puffins ignore the large colony of lesser black-backs nesting about 75 yards above them, in the bracken.)

13.00. Gull scare. Exeunt puffins. I creep out and set the clapnet in another attempt to catch Limp. I should like to ring him, and also to examine his injured foot.

13.05. Two puffins run up to net, poke about, and one gets caught. I take him and clapnet inside the hut and ring him. Not Limp, but nevertheless a male—by the size of his head.

13.10. Assembly has reassembled to a total of about 150 birds. I allow trapped puffin to escape from under the hut on a length of string. He flaps about trying to get free, attracting the notice of Limp and two others, who approach inquisitively and behave as if a fight has started. But they are put off, on drawing close, by the violence of the captive's flapping and growling. He is a great attraction, but they can't quite make him out. At last I pull him back under the hide and, untying the string, set him free. He rushes into the air, watched by many curious beady puffinaical eyes.

13.15. Complicated matrimonial situation developing. A small-head (female?) with yellow legs goes up to Limp and tries to bill him in front of Loving, who joins in. For two seconds the two hens bill, one each side of Limp's big face! Limp suddenly seems to realize what a scandal is going on. He stops and gives the Small-Head-Female a gentle nip in the face, as if in reproof. Then he turns and limps slowly and majestically (as it seems to me) uphill through a gallery of watching puffins which had begun to cluster around at the first bout of billing. Loving remains on her doorstep, but the S.H.F. deliberately follows Limp, makes a little run and catches up with him. She tries to bill Limp. He stops or hesitates, then turns and bills her so vigorously (passionately as well as angrily, it seems to me) that, as he is above her on the slope, she is pushed backwards. This behaviour by Limp might be interpreted as a nice bit of sly love-making. It is curious enough for me to wonder if Limp really planned to conduct a little unfaithful nose-rubbing at a discreet distance from home. At any rate it took place outside his threshold, which earlier in the spring was defended territory; in no man's land male puffins flirt with unrelated females, as they do in the spring rafts floating on no man's sea. What was interesting was the desire of the S.H.F. to flirt with a particular male, Limp, whom she followed away from his home. Had S.H.F. lost her husband (by her pale legs she was a breeding bird), and was now feeling lonely and unloved? She had certainly initiated the flirtation, and his had been the response of a healthy uninhibited male. Now he pushed her so hard that she all but toppled over. Recovering she pressed against him once more, only to receive the same vigorous nuzzling. As usual the flirtation was broken up by three or four spectators becoming too active. S.H.F. was lost to sight in the *mêlée*. Limp limped home.

13.20. A general restful spell, enabling me to write up my notes to the nearest five minutes. 150 birds in sight (that is, fifteen per cent of 1,000 adults to the 500 burrows). Some sit with the right or left foot lifted up and buried in the white belly feathers as if to keep it warm. To do this they are half careened, showing much white plumage, as when basking on the water. Plumages are still more faded now, the middle of the back and the edges of the primaries are grey-white.

13.25. A small-headed hen with yellow legs and thin white line joining at the back of the neck (she may be S.H.F., but without ringing I cannot prove her) plucks and carries a piece of grass into a burrow, hesitating a little on the brink. She comes out again quickly and collects a much larger billfull, and takes it below without hesitation. Returning with empty bill she makes up another burden, plucking grass without seeming to open her bill, and gradually accumulating a large wad of it; demonstrating to me how easily fish must be gathered and held in that marvellous grasp.

13.35. Puffins ignore an aeroplane flying at 1,000 feet, just as they ignore oystercatchers or rock-pipits at one foot. But all depart on the swoop of a great gull at ten feet.

13.40. This is where I sneaked out of the hide to interview a *lundapisa*.[1]

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[1] In the Faroes, when someone at a social occasion desires to slip outside for a drink, etc., he may excuse himself by saying that he has to interview a *lundapisa* (young puffin).

CHAPTER XIII

MIDSUMMER NIGHTS AND DAYS

I think I could turn and live with animals, they are so placid
and self-contain'd;
I stand and look at them long and long. . . .
Not one is dissatisfied—not one is demented with the mania
of owning things . . .
Not one is respectable or industrious over the whole earth.

WALT WHITMAN.

OBSERVATION at three o'clock on the morning of 4th July showed me that a very few adult puffins were sleeping in burrows at this season. Nor were any to be seen on the sea in Crab Bay. They were spending the night offshore, and the well-grown chicks were capable of keeping house alone during the dark hours—after all they had little to fear; I never saw a rabbit enter a burrow occupied by a young puffin (although it may have done without my knowing), and perhaps the stench of the guano outside the entrance, and in the burrow, might warn off the rabbit, which has a very sensitive nose. There were no other serious enemies —mice might have feasted on scraps of fish dropped in the burrow during the feeding ceremony; and ticks and mites were minor annoyances.

There was no assembly for a few hours after sunrise; during that time the adults visited the land only for the purpose of feeding the chick. The highest peak of fish deliveries again occurred in the early morning. There was a lull during the middle of the day, followed by a smaller intensive fish delivery in the evening, when I again entered the hide. The graph (p. 93) shows that on an average less than two fish deliveries per burrow were made in one whole day. It is doubtful if the chick could assimilate more than two, three, or four beakloads (20–80 small fish) in the course of one day.

19.30 hours. This is the social hour, with some feeding. Ten adults have arrived with fish in the last five minutes. There is a strong onshore wind from S.S.W. whistling through the louverboards, making it cold in the hut, but easier for the puffins to alight and take off. About 200 puffins present, and more arriving. Much bill-rubbing, less sleepiness. Two herring-gulls on the alert at the fish-snatching game.

19.32. Limp alights. Standing with his face to the burrow he utters a growl: 'Aar-haa-haa!' His nape feathers are slightly but noticeably puffed out in 'song.' A second later Loving arrives, and she immediately plucks a few grassy bits as she touches down. A puffin in a nearby burrow growls, as if in reply to Limp. Almost at once there is a growl from another burrow. The growl, as I have noticed before, appears to be somewhat contagious; although it is comparatively seldom uttered, and then most often in the spring.

19.35. Puffin with heavy load of fish alights and walks into a burrow. Three bystanders walk up quickly and peer with craning necks into this burrow. A herring-gull wanders on foot through the colony; as long as it is quiet the puffins allow it within about two feet, but will fly or walk away if the gull comes nearer or opens its wings.

19.38. Seven adults close in on a fight. It breaks up. About 500, or half the maximum adult population (exclusive of non-breeders, that is), present on the 500 burrows.

19.40. Can hear a young puffin cheeping in a burrow near me. Three adults run to a burrow and listen. This gives me an idea. I imitate loudly the wheezing 'chip-chip-chip' of the nestling. Puzzled puffins cock their heads at the little wooden house which they have grown accustomed to. Two step forward and listen in the entrance to a burrow which runs underneath the hide. I am flattered by this response to my poor imitation of the chick's squeak.

19.55. Still a few puffins arriving with fish. Limp and Loving are idle and walk around, but soon return to sit on the soiled lawn. Loving goes smartly into her burrow for a moment immediately after her chick, without coming into the open, has fired a pellet of loose waste through the doorway, narrowly missing Limp. I was obliged to laugh. It was almost as if Loving had gone to reprimand her child. ('My dear little *Lundapisa*! Do be more thoughtful of Papa!') Of course it was only curiosity —any moving thing interests the adults during the social hour.

20.10. Great noise and aerial commotion as a fine mature great black-backed gull arrives on sea below with a gull chick, evidently snatched from the cliffs. Three adult herring-gulls swoop in unison upon the G.B.B. who swears at them and flaps his wings, but leisurely proceeds to kill the half-grown gull. Three times the wretched chick swims away when the herring-gulls swoop down over the butcher; but as they rise to renew the dive the great gull resumes his butchery. As soon as the gull chick has been worried to death and lies floating on the dark surface of the water, the G.B.B. seems to lose interest, and flies to a nearby rock, calling loudly, however, as if to attract its mate. The dead chick is visited by two of the herring-gulls, which presumably are its parents; they hover above, as if guarding the lifeless body, and wail loudly.

20.15. G.B.B. still on rock. Corpse floats while one herring-gull alights on the water and swims beside it. After passing round it twice the herring-gull seems satisfied that it is dead and flies off. Will the G.B.B. on the rock take the corpse now or was it just in a mood to slay wantonly?

20.30. The answer is provided by a second G.B.B. which comes silently *swimming* into the bay, making straight for the dead gull chick, watched but not molested by the herring-gulls on the rocks twelve yards away. G.B.B.2 eyes the floating body warily, then beaks it over, before *swimming* with it to a rock away from the herring-gulls. I don't at first understand the reason for this laborious swimming, when flight would be easier, but it is possible that the second G.B.B., called down, as we have seen, by its mate, had decided that a stealthy approach by swimming would escape the attention of the parent herring-gulls. The G.B.B. is certainly a sly bird, which is to say it is as capable of planning and carrying out an ambush or surprise attack as any other bird or beast. Also the herring-gull is known to react more violently to the movement of a flying bird . . . but let me finish the story of the murdered chick. G.B.B.2 swims to the rock where G.B.B.1 is standing, and with an effort drags out the waterlogged corpse. This it beats on the rocks, swallowing fragments of red meat as these become detached. G.B.B.1 draws nearer but does not interfere; and now, as if afraid of 1, G.B.B.2 makes the most strenuous efforts to engulf the remainder of the substantial meal.

With painfully stretched neck G.B.B.2 jerks the mangled carcass down, but for a while the two long shanks and webbed feet protrude from the swollen maw. G.B.B.1 yodels, but probably approvingly; no doubt it intended from the first that G.B.B.2, obviously its mate, should have this prize which it had so casually dealt with. At last the meal is under hatches, and G.B.B.2 rises heavily and flies to an outer rock to digest, leaving G.B.B.1 alone. Whereupon one parent herring-gull rises up and swoops at the stationary G.B.B.1, as if on a final impulse of resentment. Or did the opening of the wings and departure of G.B.B.2 catch the eye and cause this reaction of the bereaved herring-gull, so that it flew at the nearest enemy, the great gull, which was also nearer to its nest and surviving chicks? At any rate G.B.B.1 is moved to fly calmly to join G.B.B.2 on the distant rock.

There is no doubt but that the great black-back is cunning. In the Skokholm Bird Observatory records for 1951 there is this interesting evidence by S. P. Walters: '24th April. While watching puffins in Hog's Bay this afternoon I observed a pair of G.B.B.s innocently sitting on the water at a distance of about twenty yards from the main flock of puffins. After a while the gulls then swam in among the puffins which formed a circle at a respectful distance. One of the gulls then swam out of the circle and round the outside, and then advanced towards the puffins which, forgetting the gull in the middle in their panic, rushed inwards; whereupon the central gull skated across the water, and dealt (a puffin) three quick blows on, as far as I could see, the head. Both gulls then ate the puffin together on the water.'

* * * * *

20.46. Getting dark. Much activity still. 400 puffins on land. Large rafts of shearwaters flying past Crab Bay with the strong onshore wind. Limp flies to sea.

20.48. Some bill or head-cocking, and nose-rubbing. Fish deliveries seem to have ceased. A good deal of peering into burrows. Bed-time? It's raining hard, too!

20.50. Many puffin faces are turned towards the burrows. After billing with her mate (?) a hen walked away awkwardly and bumped into another small-headed puffin. Her tail was cocked up and she jumped rudely at the face of the other, who flew to sea.

21.00. Limp returns and enters the burrow with Loving. They have gone to bed at last, I say to myself.

21.02. A bad guess on my part. Both emerge. Neighbour emerges from adjoining burrow at same time. Limp and Loving walk over and the three squat together. Another pair join the trio. One goes into the burrow there, but comes out again. So there are five of them sitting around the entrance to one burrow, quite amicably. Looks exactly like a committee meeting. Perhaps the fall of dusk brings a new feeling of companionship? Is the prayer of the mariner puffin a reversal of the sailor's prayer: 'Lord, protect us from the evils of the night on the *land*?' The sea is really the home of the puffin, not the land.

21.05. It is quite the best kind of committee, absolutely silent, with everyone sitting at ease. Near us one lone bird is still plucking grass in the dim light. Others are taking off, but some are still landing.

21.12. About 250 present. More taking off than landing. None seen positively to stay below in the burrow, but this is almost impossible to prove with unringed birds in the fading light. All those near me which have gone to ground have come up again.

21.25. 120 present—at a guess. Limp and Loving take off together. Only one bird left at entrance to burrow where five were in committee 23 minutes ago. This bird keeps hesitating about going to the bedchamber, trotting inside and at once pattering back nervously as if unable to decide. A pair near by are in the same havering condition. Others are going to sea, one by one, or in pairs.

21.28. One comes out of a hole and flies off. Some arriving still, but more taking off. The hesitator now sits in burrow mouth, facing the sea. This indecision is amazing!

21.30. Hesitator goes below after all! About 100 left, as far as can be counted in the poor light.

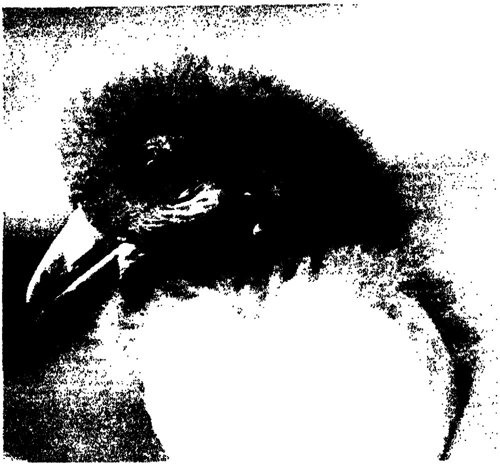
21.35. One runs up to a hole, goes in and comes out again, very undecided. Has another quiz at hole, then flies off.

21.36. Limp and Loving have not returned. About 50 present. They are taking off—not going below.

21.45. Estimate 25 only. Hesitator has not appeared—at least I have not seen it.

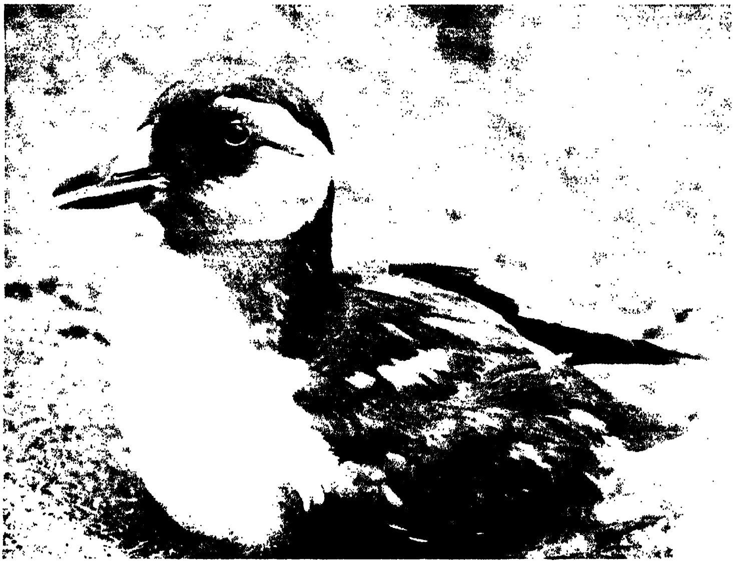
21.50. Too dark to see more than three white blobs. I am stiff with cold and inaction. At 22.00 I leave, disturbing the last puffin, which goes into the wind and rain over Crab Bay. But as I cross the burrows I hear an adult growl from underground, far from Hesitator's hole. More than one adult is underground. It is possible that the non-breeding visiting puffins also spend a night or two ashore.

Since this diary was written I have found what were probably non-breeding adults in freshly excavated burrows at night, at Skomer, in July 1952. So I incline to believe that these younger members of the community may spend their first nights ashore (since leaving land as fledglings two or three years earlier) in this 'sweethearting' period of midsummer, provided they can obtain possession of an empty burrow, or dig a new one deep enough to 'play house' in.



R. Atkinson

The puffling: about forty days old



R. M. Lockley

The puffling: fifty days old, deserted, fasting, on its way to the sea

CHAPTER XIV

THE PUFFLING

Come away, Children, call no more.
Come away, come down, call no more.
Down, down, down; down to the depths of the sea . . .
At midnight, when soft the winds blow;
When clear falls the moonlight; when spring-tides are low.

MATTHEW ARNOLD.

A NEW, and to the watcher, strange, alteration in the attitude of the adults to their chick is now taking place; as soon as its first plumage is well grown they become careless about feeding it, and this indifference changes in a few days to desertion of the plump black-and-white child, which, except for the black beak, face, and legs, resembles the adult in miniature. Before the young puffin is able to leave the burrow the adults will cease to feed, and very soon cease to visit, it. Nearly twenty years ago I discovered and reported this interesting fact; but I was still anxious to secure more details about this seeming unnatural forsaking, this sudden cessation of parental affection. I had also found that the same desertion of the solitary chick took place in other sea-birds, notably the Manx shearwater and the storm-petrel; but these tube-nosed birds took a long time over their incubation and fledging (the shearwater 124 days, the storm-petrel 100 days), so long that it was almost understandable that they would weary of the process, which prevented the departure of the adults before autumn was well advanced. But here, from mid July onwards, the adult puffins were already deserting their chick, having spent only 40 days incubating and 40 days in rearing, or 80 days from the time of egg-laying late in April and early May.

The alteration in the parents' attitude was not easy to observe, since, with some juveniles much older than others, adults were still coming to land in July to feed young birds when older chicks were already abandoned. It was by the accident of finding young puffins wandering about alone at night that I had first realized that desertion took place.

At the puffinry the change is only visible to the regular watcher who studies the routine of the parents. Their visits to the burrow become less frequent, less demonstrative, more leisurely. They indulge more freely and for longer periods in social meetings with other adults. They forgather at the cliff edge in dense assemblies, forgetting the plump and by no means dissatisfied baby at home. Less and less fish is brought into the colony. At last the parents *seem* to forget their child altogether, but of course it is not possible to prove that they are no longer aware of its existence. It may occasionally be visited by them or by other idle and curious adults. But from about the fortieth day of its existence (out of the egg) it is no longer fed, even if it is from time to time, perhaps accidentally, visited by adults.

It is an instinctive desertion, part of the inherited pattern of breeding behaviour of the puffin but, unlike the temporary desertion of chicks by other species at fledging time in order to induce the youngsters to leave the nest, it is a permanent one.

What happens in the depths of the burrows from day to day at this critical moment in the life of the young bird? I wish I knew more fully. At this stage I have heard the deserted puffin utter its plaintive call, which is exactly like that of the downy farmyard gosling:

'Whee-er-er! Whee-er-er!' it wheezes and whistles as if complainingly. It is an exhalation, squeezed out of those almost silent lungs, a more mature speech than the first 'chip-chip-chip' uttered by the new-born chick. 'I am lonely, I am deserted! Pity me!' it seems to whisper to you as it lies in your hand, a soft ball of black-and-white feathers, still with a ruff of down about the neck. But when you release it, the chick waddles off with a considerable appearance of independence, and if it is daylight seeks the darkness of the nearest burrow immediately.

When I first came to live on Skokholm I was interested to find that the young guillemots and razorbills which left the cliff-ledges in July were always attended at sea by the adults, which jealously convoyed and protected them, and answered their shrill cries. But the young puffins which I encountered at sea were always quite alone, and quite silent.

After little more, and sometimes less, than a fortnight of existence on the ledges the young guillemot and the young razorbill abandon the dangerous cliffs, and while still half grown, and less than half the body-weight of the adults, flutter down to the water on quill-less wings. They receive the protection of one or both of their parents, who encourage them to dive if danger from the air threatens, and who continue to catch fish and feed the tender fledgeling. It is a wonderful provision of nature—this reduction of the dangerous period on the cliff-ledge where the chick is exposed to predatory gulls and the risk of a fall from its narrow foothold. No doubt there is evolutionary force at work here: the shorter the period it spends on land the more sure of survival is the chick.

The young puffin, on the other hand, need not be in such a haste to reach the sea. The burrow is a comparatively safe place, soothingly dark and weather-proof and free of enemies. Instead of a mere fortnight on land, therefore, this young auk remains well over a month and up to seven weeks underground. There is time to grow a complete winter plumage and strong wing and tail quills, during six weeks of feeding on little fishes and sand-eels, of which the 'puffling' (as my daughter called the nestling) probably consumes about 2,000 before it is deserted and the supply ceases.

After the first discovery of lone puffin chicks wandering about at night (some of them blundered over the wall into the enclosed garden at Skokholm in July and August 1928, and failed to get out again, remaining for me to discover them in the morning) I kept marked burrows under observation. By placing matchsticks firmly upright in the mouth of these I obtained, after some failures, three detailed results of the whole breeding season.

Nest	*Year*	*Egg laid*	*Egg hatched*	*Incubation period*	*Chick deserted*	*Chick flown*	*Fledging period*
A	1931	Apr. 30	June 9	40 days	42nd day	July 30	51 days
D	,,	May 6	,, 18	43 ,,	39th ,,	Aug. 4	47 ,,
F	1933	,, 5	,, 16	42 ,,	43rd ,,	,, 4	49 ,,

These three were the only complete records. In other marked nests (they were in more populous places) the adults, and perhaps the young, repeatedly plucked out my matchsticks and spoilt the record. But at fledging time the telltale matchsticks remained upright in the burrow entrances of nests A, D, and F, on the 42nd, 39th, and 43rd days respectively. The chick frequently came to the entrance during the day and sat a few inches inside, clear of my markers, sometimes uttering the plaintive gosling notes. But gradually the deserted chick became silent. Then one night it had gone—the matchsticks had been brushed aside and there was no sign of the chick within, save nest debris and down. These three burrows were shallow enough for me to place an inspection lid of turf over the nest-chamber in order to record the incubation and fledging periods.

What mysterious inward force guides and decides the young puffin to take its first walk to the sea? Is it hunger? Is it thirst? Does it hear the enticing song of the sea beating on the rocks far below?

As to hunger, the intestines of such as these abandoned fledgelings which I have examined have contained no nourishing food. Only the gizzard has retained some roughage—traces of greenish bile-stained material which might have been remnants of fishbones with an admixture of plant or grass stems. The young puffin evidently nibbles and swallows vegetation and debris during its fasting period, probably taken from the scraps of nesting material in the burrow. One deserted fledgeling which I opened had a tough grass stalk an inch long at the entrance to the gizzard.

At this deserted stage the young puffin is not quite so large as the adult. Twenty-one adults weighed at Skokholm averaged 386 grams. Six fledgelings captured at night on the cliffs at Skomer in July 1952 averaged 272 grams, or about one quarter less than the adults.

Uneducated in the ways of the sea, which it may never have seen as yet (except accidentally from the mouth of its burrow if this was at the cliff edge), the fledgeling puffin does not hesitate once it has emerged from the burrow at night. It may have walked to and fro in the passage for many a night previously, but once it leaves by the front door the puffling never goes back home again, as does the abandoned shearwater fledgeling. It walks quickly away from its burrow, moving downhill, and as all slopes on the island lead to the sea it is on the right course even if its burrow is a mile inland. There is no fumbling or pausing at the cliff edge. Over it goes, into darkness and space, and, finding itself airborne, it flutters downwards briskly. Perhaps it will strike a rock instead of the sea. If so it does not appear to be mortally hurt. Its short wings have lessened the force of the impact, and its cushion of breast feathers and down has served as a buffer; it bounces from hard and soft surfaces alike, and plunges into the sea.

One dark night in July, a few minutes before midnight, as our yacht lay at anchor in Skomer North Haven, a bird struck the water alongside. Our torch showed us the dusky face and white breast of a young puffin. Bewildered by the strong beam of light it dived several times beside the white hull of the yacht, coming up to the surface each time and blinking its little opaque brown eyes uncomfortably. Brave little diver—in the depths of the sea, as in the depths of the burrow, you instinctively find safe cover!

The exodus to the sea takes place as soon as darkness falls over the island; and if the observer wishes to capture the night-walker he must be early abroad on this mission. After the first hour of the new day all those which have made a start during that night will have gone to the sea. In this early departure by night the young puffin shows an innate wisdom; it secures time in which to swim far away from the land and from its enemies, chiefly gulls, which are concentrated there.

And what of the puffling's behaviour at sea? How may we study its first reactions if it constantly makes its first plunge into salt water at night?

The only way to observe this is to collect a few fledgelings at night and release them in the sea in the light of day. We made many such tests. Dropped gently upon the surface on a bright July morning, the young puffins would swim eagerly in the direction of the broad blue ocean, their wings often half open on the surface. Almost at once they would dive; we could watch their progress through the clear blue-green water. Using their wings, with primaries closed like the leaves of a fan and thus providing a stiff oar or paddle, each puffin swam rapidly with easy distinct strokes, but not regularly using the legs like a human swimmer. These webbed limbs trailed behind, against the tail, forming with it a rudder, just as they do when the puffin is turning, banking, and manœuvring in the air. When coming to the surface again the little black legs floated forward, ready to paddle the bird in normal swimming motions.

The average of 45 dives taken by ten fledgeling puffins was 21 seconds (extremes of 9 and 27) under water; this is so long for a bird which is making its first acquaintance with the water that one wonders if it is not due to the desire to hide from the light, a desire well exhibited by the young puffin when taken from its burrow earlier in life. Does it dive deep, looking for a refuge as it swims close to the bottom of the bay; but at last is forced to rise to the surface for air? It looks like it. The intervals of resting on the surface are so short—averaging ten seconds at first —between dives, that we may be justified in concluding that the diving reaction is one of fear or panic. The intervals at the surface grow longer as the bird proceeds towards the sea—as if it was becoming less frightened, and more able to bear the light of day.

Some individuals appeared bewildered when taken out of the darkness of the box in which we had placed them when collecting them at night. When dropped into the sea they swam at first towards the land. But the majority made straight for the open sea in a series of dives with increasingly longer intervals at the surface. On the way they sipped water, holding the head up afterwards like a thirsty farmyard hen; and most of them washed themselves vigorously at the surface as they swam seawards.

One puffling, released from a good height, struck a mooring cable suspended over the island harbour, and dropped perpendicularly as if killed, plunging straight to the bottom in two fathoms of clear water. Then as if possessed by some devil of panic and imbecility it swam, perpendicularly up and down, from top to bottom of the water, at tremendous speed and without a perceptible pause for breathing at the surface. After nearly two minutes of this extraordinary performance it paused and floated on the surface, head to one side, quite exhausted. It resumed the performance a second and third time with decreasing vigour, and, gradually recovering, proceeded more normally towards the open sea.

The instinct to dive must be part of the fledgeling's inborn desire at this stage to hide, a protective function which is clearly demonstrated when a predatory gull approaches. The young puffin dives deeply, coming up far away from the gull, which can make only the shallowest of dives.

Thus, quite alone, the little black-nosed puffin, with the brown eyes dull as if from long confinement in a burrow underground, has reached the water, and is eagerly making its way towards the infinity of ocean.

Every morning in late July and early August the night's contingent of young puffins could be seen swimming, each separated from the other, unwilling to be social, drifting on the powerful tide-races of the Wild Goose, the Broad Sound and Jack Sound, near the islands of Skomer and Skokholm. But by midday they had travelled far beyond sight of the observer who tried to follow them with binoculars from the emptying slopes of the island cliffs.

CHAPTER XV

A RETURN VISIT TO BURHOU

The sea is calm to-night,
The tide is full, the moon lies fair
Upon the Straits;– on the French coast, the light
Gleams, and is gone.

MATTHEW ARNOLD.

ON THE Welsh coast the puffins arrive in late March and depart early in August. In the Orkneys they are a fortnight later, in the Faroes mid April is the arrival time, while in the arctic—Greenland, Spitsbergen, Novaya Zemlya—snow and ice prevent a landfall before May, which means that, with ninety days between egg-laying and the departure of the chick, late August is the normal end of the breeding-season in the high north.

What, then, are the periods observed in the southern limits of the puffin's range? Brittany and the Channel Islands are the southernmost breeding-sites, and the largest colonies are on Burhou (Alderney) and Les Sept Îles (Côtes-du-Nord, some 80 miles south-west from Alderney). Although only two degrees of latitude south of Pembrokeshire, the Channel Islands have a warmer climate, a shallower and warmer sea, and a correspondingly earlier spring. When Peter Lewin and I sailed there on 28th June 1949, we estimated that the affairs of the great puffinry of Burhou were about a fortnight further advanced than those of the Pembrokeshire colonies.

The yacht, *Riduna III*, piloted by her owner B. M. Arnold, sidled across the notorious race of the Swinge on the low-water tide to the harbour of the lower islet, Little Burhou, where we landed our gear and food. Our headquarters were the ruins of the cottage on Great Burhou destroyed by the Germans, our tent a staysail borrowed from the yacht, which presently sailed away and left us alone with one hundred thousand puffins. We put up a hide and made a meal of bread, fruit, and wine, while the great ellipse of flying puffins soared over our heads.

The blue Swinge tide had turned and was now flooding northwards, hissing over the rocks at our feet. The sky was a delicate rose-colour all round the horizon, deepest where the sun touched a streak of golden cloud above the tower of the lighthouse at the east end of Alderney, whose church spire, woods, and drought-brown fields straddled the southern view. The gannet-whitened Garden Rocks marked the western extremity of Alderney. Far to the west lay the snowy cone of Ortac's gannetry.

A solitary blue-tit joined our supper party—a strange guest on this treeless isle and obviously an early wanderer on the autumn migration or dispersal from the nesting area. It may have come from France. It was a juvenile and so exhausted that it was tame and without much fear of human beings. We watched it hop over the sandwort spurrey carpet, between burrow and burrow. It pecked at the insects and the large flies which were the first of nature's army of scavengers settled on the corpses of many newly dead fledgeling puffins lying about all over Burhou.

The lighthouses began to flash as the sun touched the horizon and vanished with a green flick. On the French coast the Cap de la Hague light gleamed in the sky. Alderney lighthouse in the east exhibited four regular beams, answered in the west with three globules of liquid light from the Casquets. Still the puffins were bringing in fish, or parading on every castellated knoll and promontory. By 19.30 hours the peak of the social assembly had been reached. Now the Channel wind, which had sustained a hundred thousand beating wings, began to fail, and soon a blessed calm lay upon the grey and yellow granite tors.

By 22.00 hours the movement of adult puffins had ceased. Wandering about the island we heard the purring notes of the storm-petrels which fluttered like huge moths over the rocks, their course dimly marked by the flash of the white rump as they receded before us.

We began to watch for the march of the young puffins to the sea. But why were so many dead, with most of the corpses showing no sign of death by violence?

Just before midnight the first puffling walked out of its burrow and made straight for the sea. There was very little hesitation. As if it had finished with all deliberation over making this tremendous voyage, it moved briskly to the water. It tumbled over small rocks and other obstacles, reached the slight cliff, and whirred down on stumpy wings. It struck boulder, beach, and sea in that order. On Burhou the cliffs are low and the descent is usually more of a scramble than a fall through space. The beam of our powerful torch showed that the puffling was safe in the water, and almost at once it dived.

At that moment a solitary Manx shearwater, passing over the dim sloe-black Swinge, gave out its wild crowing call. It was the first time I had heard this bird in the Channel Islands, where it does not breed, and it brought back to me memories of nights at Skokholm studying the fledgeling shearwaters. What a contrast these fledgeling puffins were! Through long practice of walking to and fro between nest and latrine within the burrow the young puffin, as we have seen, is quite nimble-footed. It may have exercised its wings often in the nest, but if so it must have found the burrow rather cramping. I must repeat that I have never seen the young puffin sitting outside its burrow like the young shearwater, which exercises its wings there night after night before finally taking to the sea. The explanation is simple: the shearwater at the burrow mouth is paying its first visit to the outside world; it has never before walked to its own front door, and it quite lacks the upright practised stance of the young puffin. Deserted by its parents the young shearwater is impelled at last to shuffle along the passage upon bent legs, until it reaches the exit; there it remains in a helpless attitude, beating its wings at the threshold for the first time in its life. It cannot walk properly, and at first it cannot fly; it can only shuffle over the ground, and it does not dare travel to the sea until it has spent several nights in stretching and exercising its wings on its front doorstep. Until it is ready to make the journey to the sea the lonely juvenile shearwater retires to the safety of the burrow before dawn—and the predatory gulls— surprise it.

Not so our deserted puffling. We have already described the bold exit, the impetuosity which makes it difficult to catch at the burrow entrance. Our torch may momentarily pick out the little white breast in its dazzling beam, and for the moment the bird is dazed enough for us, provided we keep the light steadily on it, to seize it in our hand. Often it walks away from the light, hurries away downhill, and flutters to the sea. For this reason—of a swift journey to the sea soon after nightfall—it is possible to surprise very few juveniles between the burrow exit and the water.

That night on Burhou the majority of young puffins easily caught were in a weak state, due, not to the enforced fast for which they had been prepared by nature, but to a plague of blood-sucking mites which infested the burrows. Some were in the last stages of exhaustion, covered with crawling mites (which are active only in the dark), barely able to move, or unable to walk more than a few steps at a time, or already dead in or near the entrances to the burrows. Specimens of this mite were collected and later were identified at the British Museum of Natural History, where they were found to be the common red or poultry mite, *Dermanyssus gallinae*.

According to Roderick Dobson, quoting W. R. Thompson: 'In 1913 a disease seems to have attacked the colony of puffins breeding on Burhou, and the whole island was thickly covered with the dead bodies of these birds.' The red mite may have caused this earlier plague too. We found it abundant in the fine dry sandy soil of the island in this exceptionally dry warm summer of 1949. The unfortunate juveniles which we handled that night were covered with hundreds of mites whose bodies were distended with blood. Probably in wet summers the mite does not multiply so rapidly, otherwise the puffins at Burhou could hardly maintain their numbers as they do, year after year.

Three hours after midnight the cool swarthiness of the night was over, and though the petrels were still crooning and flying over the stones by the shore, the eastern sky was touched with alabaster. At that hour, as we crept under *Riduna's* staysail for a morsel of sleep, the first adult puffins were flying overhead.

When the sun rose it was deliciously warm under the canvas, and sleep could neither be won nor desired. Moreover fierce stray red mites had been troubling us! The tide was hurrying past with a sweet soothing song. There was not a cloud in the sky. The procession of puffins carrying fish had set in for the day.

We had rescued in the night a dozen puffins too sickly to walk from burrow to sea, brushed off as many mites as possible (thus acquiring a few ourselves), and placed the invalids in a box to await daylight. Five of them had died before we released the others in the sea. They swam feebly away, one or two diving, but only for a few seconds at a time. None made normal long dives—they were too weak. The strongest made for the open sea with perceptible speed, but two of them drifted about helplessly, floating at the surface with an unnatural hunched appearance, wings half open and moving with a feeble oar-like action.

Usually the wings are opened at this stage only when diving—at the surface both adult and young normally swim with feet only. *Adult puffins swimming* near by took no notice of the fledgelings, which seemed deliberately to avoid each other and the adults, as if preferring to be quite alone.

The stalwart great black-backed gulls were too busy and satiated with the abundant meal of the corpses strewn on the island to bother with the weaklings on the sea. We watched one great gull take a dead fledgeling from the burrows to the edge of the sea—this gull likes to wash its food free of dirt, and in this instance, though without premeditation, probably of lingering mites. It worried the carcass, by a series of sharp jerks of the bill tearing the flesh away until only the skin was left inverted over the skull, wings, and feet. It did not, like the hawk, hold the carcass down with one foot. Sometimes, if hungry, the great gull will swallow the head (even of the adult puffin) whole—only to throw it up later in a casting, still whole but with the soft fleshy parts, digested by the stomach juices, missing.

At 09.25 hours I entered the hide in order to film puffins. Here on Burhou the rogue gulls which were trying to snatch sand-eels and small fishes from the puffins were chiefly lesser black-backed gulls, of which there is a large colony on the island. One of these was studying the fish-carrying puffins, and making clumsy and unsuccessful rushes at them—it did not seem to be so expert as the rogue herring-gulls at Skokholm. Another was mauling the corpse of a puffling in the middle distance. It made three attempts to swallow it whole, while two adult puffins looked at it quizzically or turned to gaze the other way indifferently. Each time the gull failed it ejected the corpse, only to pick it up and try again, throat distended and head jerking viciously. After several failures it stood over the body and yodelled angrily. Once more it gulped and failed, choking down black bits of puffin fluff. At the next attempt it got the puffin's head down into its throat; violent jerks of the head and success seemed near. The meal was half swallowed, the legs and wings still showing, and the gull looked extremely uncomfortable. Moving a few paces away the gull stretched its neck and swallowed with brutish motions of the bursting gullet. Slowly the bill closed over the last leg and wing. The gull was now quite out of shape, the throat bulging in an ivory ball behind the head, which it turned this way and that in levering movements, and gradually screwed the monstrous meal towards the stomach. With all the appearance of acute indigestion the gull sat down on a little hillock with eyes half closed and neck and crown feathers puffed up like those of a sick bird.

Meanwhile the first gull had had some success with her piratical

collisions with adult puffins, and was tenderly feeding her young chick on sand-eels and tiny fishes. She picked them up one by one from the ground and held them in her red-spotted yellow bill for the chick to nibble and devour, only swallowing those which were not accepted by her child. This appeared satisfied after it had taken four or five; the adult ate the rest and at once stalked on foot through the puffin assembly, making sallies at those near her arriving with fish.

Half an hour later the first gull walked down from the hillock of digestion and called. Two gull chicks advanced from hiding. The adult made retching motions and threw up the macerated fledgeling which it had swallowed with such difficulty. The chicks, as if protesting, called shrilly, but made no attempt to eat the horrid object on the ground. The adult, after staring at it herself (as if she wondered whether the effort were worth while), picked up the puffin and jerked it down her throat once more. It stuck half-way; and now the chicks eagerly attacked it, pulling at the legs and wings and torn body. I remembered that the young gull chicks respond to food only if it is held in the bill of the adult —on the ground it has almost no meaning for them until they are big or at least half grown. There is a bright red spot painted on the lower mandible of the adult, and this is said to guide the carnivorous baby gull, which stabs at it and thus comes into contact with the food held in the mouth of the adult. But these chicks could get little satisfaction out of pulling at the legs and wings of the puffling. They called shrilly and tugged unavailingly. Suddenly the parent, tired of this unprofitable struggle jerked the carcass down out of sight, and, marching back to the hillock, sat down uncomfortably. The chicks subsided in the spergularia. Evidently supper was not quite prepared yet!

For the rest of that day nothing significant that has not already been recorded in this book appears in my diary. Some adult puffins were still carrying feathers and scraps of nesting material; some—among them young non-breeders—were still flirting with mates and neighbours. One bright-legged fellow, obviously free of family cares, burrowed enthusiastically in a blind hole, sending out a cloud of sandy dust.

At noon activity in the assembly eased off, only to be renewed early in the evening. Rock-pipits were feeding their young. A procession of migrating blue and great tits amused us as they searched the granite tors near the hide for insects.

We stayed two nights and three days on Burhou.

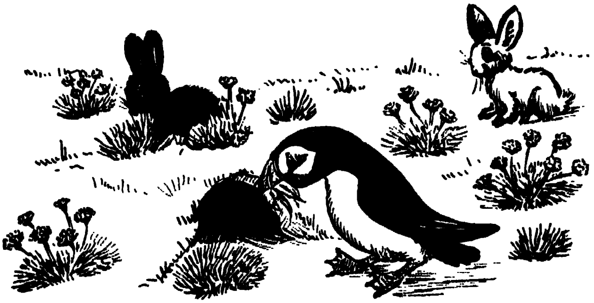
* * * * *

So far we have described and compared puffin behaviour only in the larger colonies. There were many other colonies which we visited in France, Iceland, the Faroes, and Britain. The smallest were those on the north coast of Jersey (40 pairs); St Margaret's, Pembrokeshire (10 pairs); and Cardigan Island (3 pairs). It was interesting to try to compare social behaviour in the great, with that in the minute, puffinries. Fraser Darling has put forward the theory that large flocks of sea-birds are more successful in breeding than small ones; and he has suggested that there may be a numerical threshold below which a social species will not breed at all. The success of the large flock springs from the general greater stimulation received as a result of the displaying and mating activities of the numerous experienced adults which are the first to start nesting—and so synchronization of breeding in the whole flock is promoted, leading to a shorter and therefore (because of the shorter period of exposure to natural enemies) more successful breeding-season.

If Darling's hypotheses are valid what is the lowest number of pairs of the intensely social puffin that will breed successfully?

The three pairs at Cardigan Island, believed at one time to hold a large puffinry, have never been discovered breeding, although they appear in the spring regularly close to the island shore; they may be immature birds, changing each year. The ten pairs at St Margaret's seem to breed successfully; they too are stationary in numbers over the last twenty years. Latest reports on the Jersey colony (1952) suggest that it is increasing; formerly it was treble its present numbers. Particulars of other puffinries, some stationary, many decreasing, very few increasing, are contained in the appendix on distribution. It must suffice to point out here that the most noticeable behaviour difference between large and very small colonies was the greater shyness of the individuals in the little puffinries. Puffins at Jersey and St Margaret's were not approachable with the bamboo catching rod, but flew away when the observer was scrambling along the cliffs fifty yards away; nor did they seem to congregate much on land for the social meetings observed in large puffinries. They were wild, and flew down to the sea, and floated in rafts there. The odd birds at Cardigan Island are rarely seen on the land: year after year in the spring they float on the water under the cliffs, as if waiting for others to come, and swell their ranks, and enable them to cross the numerical threshold to successful breeding and a recolonization of their ancient fortress.

Nevertheless, in spite of this evidence, odd pairs of puffins nest in holes widely separated from and out of sight of each other in crevices in the limestone cliffs of South Pembrokeshire; but the stimulation to breed may be derived from neighbouring pairs of other social species, such as the razorbills, guillemots, and gulls which frequent the same cliffs.



CHAPTER XVI

EXPECTATION OF LIFE

> Into this Universe, and Why not knowing
> Nor Whence, like Water willy-nilly flowing;
> And out of it, as Wind along the Waste,
> I know not Whither, willy-nilly blowing.
>
> EDWARD FITZGERALD.

ALL THE adults have gone; and soon the last of the fledgelings follow, to make their solitary way far out into the ocean, where we lose touch with them in the autumn mists and gales. We are back full circle to where this book began—the pelagic or winter half of the puffin's year.

What else is there to record of the life-history of *Fratercula arctica*? What news of the other subspecies—the arctic *naumanni* and the subarctic *arctica*—that is different from the accounts of our southern *grabae*? Almost nothing to be discovered in the scanty literature about *naumanni*, which is certainly a much larger bird than *grabae*, but probably its habits are identical. The differences between the subspecies cannot be very important at this preliminary stage of our knowledge of the species itself. This book has shown how little we do indeed know. It has produced a sheaf of questions, many of which remain for the present the subject of speculation.

One of these is the age to which the puffin may live, and its normal expectation of life.

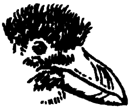
Unfortunately we have very few records of ringed puffins being recovered anywhere, either at home where ringed or abroad (see Appendix IV). For this there are two reasons: first, not many puffins have been ringed—under the British ringing scheme only 7,655 between 1909 and 1951, compared, for example, with over 40,000 Manx shearwaters in the same period; and second, the aluminium rings rarely last more than from three to seven years on the leg of a sea-bird which spends most of its time in salt water (it is also believed that puffins get rid of weak rings). The longest records we have are: Three ringed as adults at Skokholm returning to breed there four years later; another adult which I ringed at Skokholm on 28th June 1947 was found dead at Bassin d'Arcachon, Gironde, on 18th February 1951: this bird may have been three years old in 1947, and seven when it died; an adult which we ringed at Skomer 18th July 1946 was recovered (oiled) at Guernsey 9th October 1952: this bird may have been nine years old. H. W. Robinson received records from lighthouse-keepers at Sule Skerry, Orkney, of puffins (adult) returning to burrows seven years (one), six years (two), five years (one), after ringing. In Europe puffins have been ringed in France and Norway extensively. The oldest Norwegian recovery is nine years after ringing as adult; this bird may have been twelve years old—it was certainly ten years old.

The world population of the puffin is but slowly decreasing (as man and his parasites invade the puffinries). In the past it must have been almost stationary for centuries. It is sufficient for the maintenance of the species if each adult is replaced by one of its kind, fully adult and breeding, during its lifetime. The annual mortality of a numerically stable species must be equal to its annual increase. The slower the rate of reproduction the longer the expectation of life. We have seen that the puffin appears to suffer a considerable mortality on land, chiefly at the bills of aggressive and powerful gulls, which themselves produce two or three eggs each season. From this we draw the conclusion that in spite of their bold rapacity and higher rate of reproduction, the gulls are less successful than the puffin, and on the average ought to die sooner. However, it is known that the large gulls are not in fully mature plumage until their fourth or fifth summer; so that a large proportion must live for six or more years in order to replace themselves during three or more years of breeding.

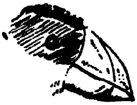
From the evidence we have gathered together in this book we believe that the puffin does not normally come to land in the second summer of its life (counting the summer of its birth as the first), which means that it is about two years old when it first returns to the breeding colony and begins 'sweethearting' and exploring burrows, etc.; and that it does not breed for at least another year, that is, until it is three years old. To reproduce itself it needs a mate; therefore a pair of puffins must be at least four years old by the time they have produced the two eggs which will replace them. But again, we ought to allow a mortality of say twenty per cent for losses during the life of the egg, chick, and unfledged adolescent; so we must add more years to insure against this loss, as well as the loss during the inexperienced years while the young birds are growing to maturity.

The above recoveries show that adult puffins can live up to at least ten years. It is interesting that the Faroese bird-netters believe that puffins do not normally breed until they are at least four (some fowlers say seven) years old; they say that the yearling birds do not come to land—and this is what we have found. In their third summer the young adults come ashore, pair, and prepare burrows, say the Faroese fowlers, who are able, they believe, to tell the age of the puffin up to ten years by the shape of the beak, and the number and depth of the transverse ridges and grooves, and the thickness of the horn near the tip, of the upper mandible. When the fowling season opens on 2nd July (*Fyrstifleygidagur*), the adult puffins are carrying fish to their chicks. These fish-bearers (*sildberi*) are never taken in the nets but are spared to carry on the duties of feeding the next generation; only the small-billed puffins, the non-fish-bearers, are killed. But as we have seen in our watch on the colonies feeding young, many adults with chicks underground do visit the colony without bringing fish, but merely for rest and social promenade; the Faroese custom is not likely to protect these breeders entirely.

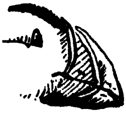
We cannot claim to tell the age of the puffin beyond five years. At one year old its bill acquires its first transverse ridge, which is separated from the blue part of the upper mandible by a very narrow groove. At two years of age a second transverse ridge has grown parallel to the first: it is not so well developed as the first ridge, but it thickens by the time the puffin comes ashore in the third year of its life. At this age the puffin may or may not breed; probably some do and the majority do not. In the fourth year a third transverse ridge is developing, and this is probably perfect by the time the puffin is five years old. In the oldest birds I have handled there are signs of a fourth ridge, and the beak is thickened beyond, close to the point of the upper mandible. The ridges continue in the same sweeping curve across the lower mandible but are not so distinct on this portion of the bill. Sometimes the ridges are slightly more plain to see on one side of the bill than on the other.



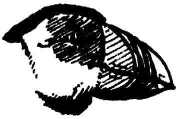
1 WEEK



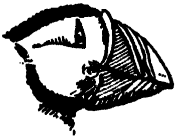
6 MONTHS



12 MONTHS



MATURE WINTER



MATURE SUMMER

Hr. Abrahamsen told K. Williamson in the Faroe Islands that a puffin, once the first five dangerous years of its life were past, might live to sixty years. An albino at Mykines, Western Faroes, is said to have come every year to the fledging place at Tangi during that time, but in the last ten years it never came ashore! Such a statement, without details of verification, has little scientific value: in the British Museum of Natural History there are many white or partially albino puffins, the majority of which are from the Faroes. The Tangi bird may well have been a succession of albinos.

Can we make even a reasonably fair estimate of the average expectation of life of the puffin? At the present time all we know is that:

Born in June it is	0 years old.	
Remains at sea at	1 year old.	
Visits colony when	2 years old.	
May breed when	3 years old.	
Does breed when	4 years old.	
Still breeds at	10 years old.	(Appendix IV.)

An ounce of fact is worth a ton of theory. We hesitate to present a table of probabilities of the expectation of life with each year of the puffin's life, since it is estimated on much theoretical and little factual data. But it might give the reader a rough picture of the probable vital statistics of the bird. Taking the unit of 100 breeding adults (50 pairs) it is possible that these have by July produced

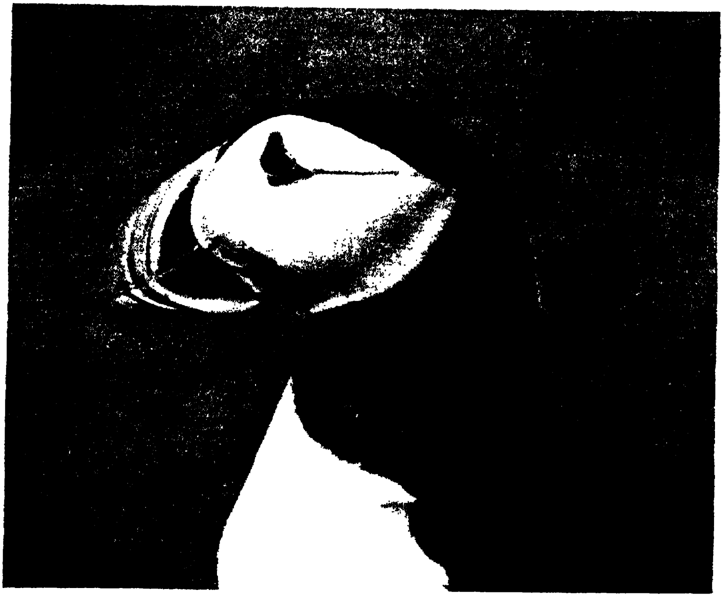
40 unfledged chicks, which by the following July are reduced to
30 juveniles living at sea, ,, ,, ,,
25 adolescents or non-breeders ,, ,, ,,
20 breeders for the first time ,, ,, ,,
15 ,, second ,, ,, ,, ,,
12 ,, third ,, ,, ,, ,,
10 ,, fourth ,, ,, ,, ,,
9 ,, fifth ,, ,, ,, ,,
8 ,, sixth ,, ,, ,, ,,
7 ,, seventh ,, ,, ,, ,,
6 ,, eighth ,, ,, ,, ,,
5 ,, ninth ,, ,, ,, ,,
4 ,, tenth ,, ,, ,, ,,
3 ,, eleventh ,, ,, ,, ,,
1 ,, twelfth ,, ,, ,, ,,

195 puffins in July of any one year, made up of 100 breeders and 95 non-breeders.

If puffins do not breed until they are four years old then the above table will have to be extended and the expectation of life increased accordingly. We agree with Hr. Abrahamsen that once the first years of inexperience are survived, the puffin would have expectation of a long life. Ringing has so far proved that one bird has lived nine years as an adult, to which can be added three years of adolescence, making twelve years (Appendix IV).

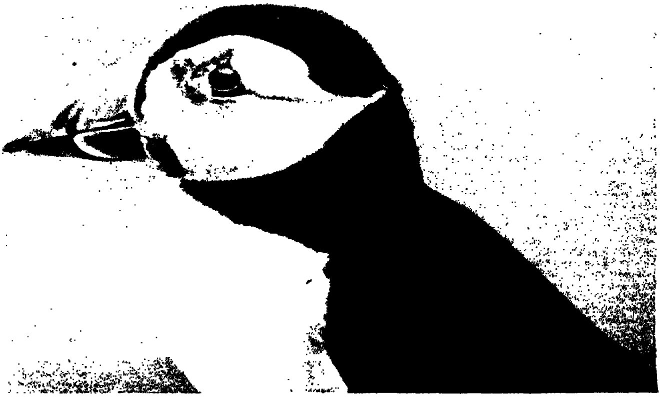
A Manx shearwater at Skokholm lived to be twelve years old; this shearwater ought to have about the same expectation of life as the puffin, which it approximates in size and habits.

Probably individual sea-birds live very much longer, perhaps twenty, thirty, or forty years. My friend James Fisher considers that a fulmar may live as long as fifty years. The potential life even of the robin, which has an average expectation of life of only a little over one year, may be long. Lack compares the life of an eleven-year-old robin (ringed by Burkitt in Ireland) with that of man, and reckoning in terms of heart-beats (disregarding, however, the fact that the heart slows down in sleep), found it equivalent to that of a man 150 years old. If a robin can live eleven



R. Atkinson

Fully mature

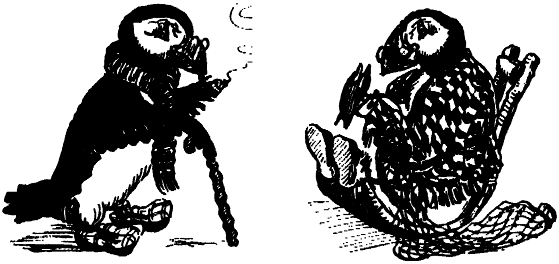


R. M. Lockley

Two years old

years, the potential life of the puffin must be longer, probably it might be thirty years; it would then be aged. Few individuals would be likely to become aged, however, since enemies are always ready to prey upon those whose natural alertness begins to fail through approaching senility. Only in captivity do wild birds, protected from weather, enemies, and lack of food, live unnaturally long lives.

This chapter must be the shortest in the book because its subject is one we know least about. Without extensive ringing, and this is not yet begun, we cannot know more about the longevity of the puffin through field studies.



CHAPTER XVII

NATURAL ENEMIES

We there, in strife bewildering,
Spilt blood enough to swim in:
We orphaned many children,
And widowed many women.

T. L. PEACOCK.

THE GULLS have been pictured as the chief natural enemies of the puffins, and their methods of predation described. But they were not the only avian predators: the buzzard, the raven, even the carrion-crow—all three occasionally attacked and killed the unwary or sick puffin. Yet these three enemies were spasmodic scavengers of the feeble and unhealthy, rather than regular predators, and had no appreciable effect on puffin numbers.

The savage peregrines were more formidable. These falcons had their eyrie in a rock niche above the sheer Wick cliffs of Skomer, above viscid ledges filled with thousands of groaning guillemots, growling razorbills, and yodelling kittiwakes, each or any of them when on the wing an easy meal for the lordly tiercel and his buxom mate. Yet the peregrines seemed to prefer the puffin and the shearwater; and at the store shelf near their eyrie only these species were found. On 2nd June 1946 we counted the remains of two puffins and eleven shearwaters in this larder. How did the diurnal peregrines take the night-flying shearwaters? One morning I found the tiercel dragging a shearwater from under a shallow rock. The peregrine evidently hunted early in the day for those few shearwaters (always to be found on Skomer) which had somehow failed to return to their burrows, or to the sea, before dawn. The popular belief is that the peregrine always takes its prey in the air. It was a wonder to me after this discovery that the peregrines never attempted to snatch guillemots or razorbills sitting on the crowded ledges below their eyrie. But they did not. And they always took puffins on the wing.

These aristocrats of the western seaboard I had often seen strike down in mid air and carry off a puffin. Their eyrie, when they bred at Skokholm, was littered with puffin remains, as was the nearest mainland eyrie on the cliffs overlooking Jack Sound, from which they hunted the islands. One day early in July a peregrine at Skokholm arrowed down upon an assembly flight of puffins in South Haven, playfully buffeting them, catching one in its talons, releasing it and dashing after another, striking the second a death-blow with the terrible keeled hind-claw, which is curved forwards at the moment of striking, then rising high into the air with empty talons. The first puffin, momentarily enclosed in the death-clasp, fell to the ground, disabled and terrified, and staggered about the turf drunkenly, then, finding itself at the entrance to a burrow, squirmed out of sight. The second lay with its head half severed from the body—it was quite dead when I picked it up a few seconds later: one glancing blow from the scimitar had sufficed. Yet the peregrine had not been hungry enough to trouble to carry it away. Puffins were so easily taken that the peregrines found amusement in this terrible wanton game.

Even if the peregrines took a puffin each day, which is not unlikely, the total of their summer depredation in a colony of one hundred thousand puffins would be less than 0·1 per cent. The presence of peregrines might be more serious in smaller puffinries, although nature has generally ensured a smooth and steady balance in the ancient relations between indigenous predators and their prey: for instance, for many years now there have been about thirty pairs of peregrines and thirty pairs of choughs in the whole of Pembrokeshire, although the peregrine preys on the chough. It is man who upsets this natural equilibrium by his gamekeeping or other controls in favour of certain species, or by the introduction of alien or domestic animals, or by the release of edible wastes, thus creating a regular artificial supply of food to the advantage, and multiplication, of scavenging gulls and other birds.

But man himself was once a natural predator of the puffin, and with his simple wildfowling devices of old enjoyed a share in the general harvest of the sea-birds. The nests of the predatory gulls were often the most accessible of this harvest; by taking their eggs and fledgelings man, to an appreciable extent, kept these rival predators in check, and so indirectly preserved for his own use as well as for their survival the puffins and other edible sea-birds which are the prey of the gulls. Now that man has withdrawn from this hunt in the north Atlantic, except on the northern islands, in Greenland, and some Latin coasts of Europe, and adopted the role of passive conservator of wild life, the gulls, ravens, crows, and hawks of the seaboard have greatly increased and more than filled the gap he has left. Even in the quarter century that I have studied the puffinries of the British Isles, France, the Channel Islands, the Faroes, and Iceland, the increase of predators in those islands where bird protection laws are in force has been astonishing. Generally at these sea-bird rookeries there has been a corresponding decline in the number of the preyed upon, especially the puffins, guillemots, and razorbills—and this decline has been noticed and reported by many observers visiting British colonies. The correlation is close enough to excite comment, and in some instances, as at Annet in the Isles of Scilly, action to check the gulls by preventing their eggs from hatching has been taken in order to reduce the predation upon the more helpless puffins, shearwaters, and petrels.

Man, of course, remains an indirect predator, in some cases by accidentally introducing, by way of ships, rats—this has happened at Lundy, Ramsey, and Ailsa Craig, where the puffin colonies have been reduced or exterminated; and by allowing mink to escape from fur farms (Icelandic islands); and by polluting the sea with waste bilge oil from his oil-carrying ships, as a result of swimming in which thousands of auks become contaminated and die miserable deaths of cold and starvation. The effect of man as a direct predator is discussed in the next chapter.

It is not suggested that the predatory gulls have increased solely because man has given up his harvesting of sea-birds for food, although this must be a contributory cause. The sea-bird harvest was seasonal—a summer banquet only. The great increase in gulls must be due to the contemporaneous development of the inshore and offshore fisheries of the world; the gulls have benefited from the abundance of fish offal which is thrown into the sea each hour of the day and night by trawlers, smacks, and other fishing-vessels, as well as from the waste fish, fish-heads, and intestines which are available at the fish wharves of seaports. Thousands of gulls also feed at municipal rubbish-dumps, abattoirs, and sewage outlets. In summer the larger gulls resort to breed on cliffs and islands often far from these man-made sources of food; therefore it is not surprising that they take what is at hand, the eggs, young, and even adults of the smaller sea-birds, since this alternative food supply is not difficult to procure.

The great black-backed gull is a typical example of this increase in the last fifty years. At Skomer in 1894 the Rev. M. A. Mathew found no great gulls at all, and recorded only two nests in the whole of Pembrokeshire. By 1946 there were 160 pairs on Skomer and Middleholm, which, together with 1,000 pairs of herring-gulls and 700 pairs of lesser black-backed gulls, must have accounted for at least 5,000 puffins on those islands in a season, if not double or treble that figure. By the end of the summer Skomer is well littered with puffin skins, although the remains of the shearwaters are even more numerous. The same is true of Skokholm, and of Annet in the Isles of Scilly. A large proportion, possibly the majority, of puffins captured by the great gull, are carried off and devoured at sea, this gull seeming to prefer to wash its bird-flesh meal as it dissects and eats it. In this way no litter is left on land of this proportion of its puffin catch.

Greater enemies than the gulls are rats. There are no rats on Skomer or Skokholm, but at Ramsey the appearance of rats long ago resulted in the extermination of the puffins, and this process is going on to-day at many islands recently invaded by rats. On Lundy Island in 1892 two ornithologists found it was 'impossible to form any conception of the incredible number . . . there would not be room for another puffin.' Mr Peter Davis of the Lundy Bird Observatory writes to me that in 1952 there were not more than four hundred pairs breeding, and they appear to have had a very bad season indeed. 'The annual decrease during the past five years appears to have been at the rate of about ten per cent. Causes: we suspect oil and rats as the most important.'

On Ailsa Craig one hundred years ago the puffin was an article of food, exported to the mainland. Immense numbers burrowed in the soil on top of this great sentinel of the Clyde. About 1889 rats made a landing, and multiplied almost as fast as the puffins declined. At the present time only a few pairs are left breeding in holes in the cliffs difficult or impossible for the rats to climb down to.

Another tale of rat infestation and puffin decline concerns Puffin Island or Priestholm, the most easterly land of Anglesey. Here Ray in 1662 compared the puffinry to swarms of bees for multitude, and in 1798 Bingley found fifty acres literally covered with puffins. After a shipwreck in 1816 or 1817 rats got ashore; the puffins declined to their present insignificant numbers of a few dozen pairs. On the Calf of Man they were once abundant but no longer breed; rats are now found in their burrows instead. So the tale of the brown rats coming and the puffins departing runs through many islands, from the lofty Shiants in the Hebrides, where large numbers still breed, though much less than formerly, to such small islets as Cardigan Island and St Margaret's in West Wales, where a few pairs of puffins survive only in the cliffs.

Sometimes the puffins are their own enemies. There are no rats on the island of Grassholm, off Pembrokeshire, yet from a vast colony the puffinry there has become almost extinct. The whole island of Grassholm, we are told, was so covered with occupied puffin burrows in 1883 that it was impossible for E. Lort Phillips to make camp on a space clear of them, and in the night he was awakened by puffins moving about in his tent. In 1890 J. J. Neale estimated that half a million puffins were breeding at Grassholm. To-day hardly a dozen pairs can be seen, and no eggs have been reported for more than a quarter of a century. From the riddled appearance of the surface of the island the change seems to be due to the collapse of the surface 'soil' through extensive burrowing. It might have been the case that Grassholm had few or no puffins two or three hundred years ago. Then the first colonists discovered that the island was covered, not with soil, but with a two- or three-foot-thick bed of turf or dried hay, the accumulation of centuries of growth and decay of the moisture-loving fescue grass (*Festuca rubra*). This was ideal burrowing material, soft and easily worked. The puffins settled, multiplied with new emigrants arriving, dug their labyrinthine cities, and swarmed until half a million birds were breeding on the twenty-one acres, which is roughly five birds to the square yard, and a maximum state of overcrowding.

The extensive burrowing drained the haystack; the surface or thatch of grass covering the holes dried out, killing the roots of the top layers of grass. The whole island gradually became bare and brown. The brittle thatch fell in by weight of walking puffins, and the occasional trespass of man, and by weather and winter storms. The tenements became less and less habitable; it was no longer possible to rear chicks safely in the dilapidated puffin city, which was now a maze of entrances and exits, with hardly any dark passages left. Gradually many of the Grassholm puffins seemed to have moved to the safer, more solid, sandstone earth of Skokholm, where, according to local fishermen, they were never very plentiful until the beginning of the present century, at which date the farming of Skokholm more or less ceased. By 1930 there were 40,000 puffins breeding at Skokholm, but never half a million—where the rest of the Grassholm community moved to is not known. It is possible that J. J. Neale exaggerated their numbers in 1890, but he was known to be a careful observer. (As a footnote, we may add that there has since been a decline in the puffinry of Skokholm, and in 1952 probably only 20,000 adults were breeding. There are no rats on this island.)

It seems to be a habit of puffins to colonize a turfy island, work it to ruin, and then, perforce, depart for new territory. The puffin is thus its own foe in destroying its habitat. Darling found that the puffins in the islands of north and west Scotland burrow into the thrift-fescue sward and 'cause such excessive drainage that the whole deposit will slough off and fall over the cliff. The puffin . . . must be a considerable influence on the denudation of soil from sub-oceanic islands.' Eight thousand puffins were killed in May 1940 on the island of Bleik, Nordland, Norway, because they were said to be undermining the soil and causing erosion.

The puffin has not many other enemies. The rabbits and the shearwaters, where they share the same burrows, are no more than rivals. Probably a determined doe rabbit would successfully defend her nest of young ones from an exploring puffin returning in the spring; but normally the rabbit is afraid of the powerful bill of the puffin, and retires when attacked for entering a burrow. Shearwaters are a different problem: they arrive on the islands earlier, even early in February, and take possession of certain burrows at least a month before the puffins. In general, where these two species share the same island, the shearwaters are concentrated inland, leaving the perimeter of the cliffs to the puffins. Shearwaters, with their long wings, and legs placed far to the rear of the body, require a broad platform on which to alight—they do not much use the narrow niches and shelves in the steep cliffs for which puffins have a predilection. But there is plenty of overlapping on the broad slopes at the cliff edge; there is no set ecological rule governing the division of this territory. By day it is covered with promenading puffins; at night it is sprinkled with shearwaters sitting outside the same burrows. I have found many shearwater eggs in cliff-edge burrows of what was in the day a populous puffinry. Farther inland there were burrows exclusively used by shearwaters or with rarely a pair or two of puffins. Not infrequently puffin fought with shearwater within the burrow, puffin growl mingling with shearwater yodel, the combatants sometimes tumbling into the daylight. Usually the fight was broken off when the shearwater found itself in the open; it would hurriedly scuttle back into the burrow, while the puffin remained outside, a little bewildered at first, before flying to the sea to bathe its ruffled plumage. This was interesting but not altogether unexpected: the shearwater, nocturnal while on land, seeking the darkness, and the puffin, active by day, remaining in the open air.

It is not improbable that the puffin occasionally incubates the egg of a shearwater by mistake, and perhaps the shearwater may incubate the egg of a puffin. Elsewhere I have related the instance of a puffin which fought several pitched battles with a shearwater for possession of a desirable burrow on a little hilly rise near the Skokholm flagstaff. After several encounters the shearwater yielded its egg to the puffin, which, however, failed to hatch it. The shearwater's egg is slightly longer and narrower (averaging 60·9 × 41·9 mm.) than the puffin's; apart from this unimportant difference, the shearwater's egg takes ten days longer to hatch, and so the failure is not perhaps surprising. Even had the puffin successfully hatched the young shearwater, the chick would have starved on a diet of raw fish as presented by the adult puffin—the new-born shearwater requires to be fed with a soft milky pap of predigested fish. Puffins and shearwaters will, I find, brood even a gull's egg if this is experimentally inserted in the nest in place of the bird's own; but I have never had the time or inclination to follow these experiments extensively in order to prove the hatchability of a gull's egg under an auk or petrel. When I visited the German bird observatory on the sand-dune islet of Scharhörn in the Elbe estuary in July 1951 I was shown a lively young guillemot which had been hatched after 32 days' incubation under a herring-gull; this egg had a curious history, having been washed up at Scharhörn, possibly after drifting 25 miles from the nearest and only guillemot colony on this coast, at Heligoland!

Then there are the specific blood-sucking and scale-eating parasites which can be, as described earlier, formidable natural enemies of the puffin. Miriam Rothschild and Theresa Clay, to whom many of these minute pests were sent by us from the Pembrokeshire islands, have summarized the information on the puffin as host in their book *Fleas, Flukes, and Cuckoos.*

'The puffin is a popular bird with fleas, six species having been recorded from it, namely: *Ceratophyllus gallinae*, *C. garii*, *C. vagabunda*, *C. borealis*, *Ornithopsylla laetitiae*, and the common rabbit flea, *Spilopsyllus cuniculi.* The shearwater, on the other hand, has one flea only, *O. laetitiae*, and it is probably its true host.'

The common sea-bird or guillemot tick is *Ixodes uriae*, in Britain 'recorded from gannets, fulmars, guillemots, puffins, curlew. . . . Ticks are very dangerous parasites. Their saliva, which they pour into the flesh of the host can be highly toxic, and the bite of one tick may kill the host. Even their eggs contain poisonous substances which can prove fatal to birds. Blindness sometimes follows attachment to the region of the eye, and the flesh of the bird becomes "pulpy" and semi-liquid in the immediate vicinity of the tick. Many fatal diseases of mammals are carried by ticks, and both the pigeon and the fowl tick (*A. persicus*) are vectors of fowl relapsing fever. The causative agent is a spirochaete (*Borrelia anserinum*), which undergoes development in the body cells of the tick. Many birds are susceptible to this fatal disease which is passed on in the eggs of the tick. The larvae are thus already infected at birth.' They add that 'Jackdaws have been seen feeding avidly on the guillemot chick.' As we know to our cost this tick will sometimes, though rarely, bite human beings. For a whole day and a night after some hours spent in ringing sea-birds I was irritated by what I took to be a 'heat bump' in the small of my back—it proved to be a well-bloated *I. uriae*!

Of the red mite, which proved so destructive on Burhou islet, the authors say that the poultry mite, *Dermanyssus gallinae*, is 'widely distributed in the nests of many wild birds, including various passerines, gulls, and pigeons . . . all the red mites are true blood-suckers and when present in large numbers may bleed the host to death.'

The same authors point out that the skuas may be considered true parasites of other birds; these gull-like birds pursue puffins and guillemots and force them to disgorge fish, which they seize as it drops through the air. This is only for the short period at midsummer when puffins are carrying fish to their young. I do not know of any other enemies of the puffin save man, and the pollution of the sea by man, dealt with in the next chapter. At Rockall on 19th June 1948, I saw a fulmar inspecting, and presently beginning to pick at, a puffin which lay freshly dead upon the water, but there was nothing to prove that the fulmar had killed the auk; it was more likely behaving in the normal way of the fulmar, scavenger of all edible waste found on the surface of the deep ocean.

Finally there may be under-water enemies. Legendre records that remains of puffin and guillemot have been found in the stomach of the angler-fish (*Lophius piscatorius*), which has also taken shearwaters, and killed itself in trying to swallow a cormorant. Not infrequently you may see a puffin with torn or partly amputated foot, presumably due to the attacks of large fish.

CHAPTER XVIII

MAN AND PUFFIN

> As for her tenants, that is, man and beast,—
> The beast we daily see massacred dy
> As thralls and vassals unto men's beheasts.
>
> SPENSER.

THE VERY earliest reference to the puffin by name (although it is probably included, unnamed, in earlier references to the taking of sea-birds for food) appears to be in A.D. 1337. At an *inquisition post mortem* of that date the Isles of Scilly were said to have been leased by King Edward III (as Earl of Cornwall) to Abbot Ranulphus of Blancminster for 6*s.* 8*d.*, *or three hundred puffins.* More details will be found in the *Descriptive Catalogue of Ancient Deeds Preserved in the Public Records Office*: a chirograph indent, dated 10 Edward III (about 1337), witnesses that whereas John de Allet holds all his lands in Scilly of 'Sir Ranulph de Blaunchminster' by knight-service and by service of keeping Sir Ranulph's castle there for a certain time, the said Ranulph has released and quit-claimed for self and heirs to John de Allet and his heirs the service of keeping the castle for ever: for which release John has granted to Sir Ranulph and his heirs 13*s.* 4*d.* rent from all his land in Brayer (Bryher), Brethiel (Tresco?), and Seynt Maudut (St Martin's) in the said isle with right of distraint; and Ranulph grants for self and heirs that, whenever de Allet or his heirs have made default in part or whole the payment of a rent of 150 *poſſonum* at the terms of a charter of Richard de Wyk contained, it may be lawful to the said John de Allet and his heirs to pay one penny for three puffins (*poſſonis*), and at the same rate for single ones.

Puffins in fact were three a penny—quite expensive in those days, since a man can eat three puffins at a meal.

Hundreds of thousands have been, and still are, annually taken for food; but for economic and sentimental reasons the practice is a diminishing one at the present time. The Wild Birds Protection Acts forbid the taking of puffins in the British Isles, where other, chiefly domesticated, fowl are easily obtainable in supply only limited by the buyer's purchasing power; but puffins are freely shot in winter off the coasts of Newfoundland, France, and Scandinavia. In the Faroes and Iceland, where the meat of domesticated stock is scarce, however, the puffin remains a valuable article of food, and its killing is regulated by local by-laws and customs.

Palatably the puffin is excellent. We have eaten it, plain-boiled or braised, in the Faroes and the Westmann Islands of Iceland. The breast is the meatiest portion, and this part and the thighs, of two puffins, will provide a man with enough meat for a meal (although a hungry man could easily eat three or four)—little else of the puffin is in fact eaten, although the carcass, including the head, makes a rich soup. It is the custom in the Faroes to pluck the bird, boil it whole, and eat the breast and thighs while holding the legs and head in your fingers. In Greenland the flesh is often eaten raw by the Eskimo, or the carcass, after skinning, may be stored in a bag made of a whole sealskin with the blubber attached; a sealskin full of puffins and little auks, well melted into the blubber, is said to be delicious after a few months of maturing in a cool cave or after a winter's natural refrigeration. There is a story, told I believe by Peter Freuchen, of an aged Eskimo woman who, turned out (as used to be the custom) to die one autumn because she had become a burden on the community, discovered a cache of a large sealskin stuffed with birds, on which she lived comfortably all the winter, to astonish her relatives, when in due course they camped near the cave in the spring, by returning to them alive and in excellent condition for another summer!

The flesh of young sea-birds is usually delicious eating. That of the fledgeling puffin, we can attest, is like a tender beefsteak; and the same is true of the flesh of the young gannet. The very slightly fishy smell disappears in the cooking; and ordinary roasting or frying seems to suit the civilized palate best.

The feathers and down form a not inconsiderable article of trade and barter in Iceland and the Faroes; they are used for stuffing mattresses, quilts, and pillows. As to numbers taken each year, probably 250,000 puffins are killed in the whole of Iceland (1950), including the Westmann Islands where some 50,000 are annually gathered. About the same number of a

R. M. Lockley

In the Faroes: islanders returning from a *fleyging* expedition

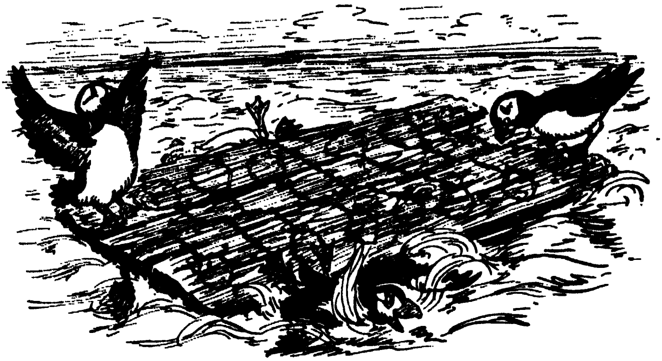
R. M. Lockley

In the Faroes: plucking puffins in the village street quarter of a million (or perhaps less) of puffins are taken annually from the great bird cliffs or *róks* in the Faroes. In the whole of the Iceland-Faroes archipelagos, then, half a million puffins are taken annually, or somewhat under two hundred tons of puffins (allowing 386 grams or 13½ ounces to each adult puffin). This may seem large in the aggregate, but in fact it amounts to less than four puffins per head of population per annum. Other sea-birds, especially guillemots, and formerly fulmars, supplement the harvest of puffins, however, although the puffin by a long way heads the list numerically.

In the chapter 'Fugle-fangst,' in the guide-book *Faeröerne Natur og Folk* we read that 'bird-catching in the Faroes cannot be described as a means of livelihood of great importance, but it is so full of excitement and colour that it well merits a chapter all to itself. . . . The fowler has a *fleygustong* (fowler's net) with him. This is a long pole 12–16 ft. forked at the end, with the net between the two forks. The fowler rests on a ledge on the cliff, awaits the birds on flight and swings out his net as they fly past. An experienced fowler can catch up to a thousand birds a day. This method of fowling, most in use nowadays, is called *fleyging*. Another method of fowling is called *fygling* and consists in putting the net over the birds, while they are sitting on the ledges of the cliffs. *Fygling* is only used when catching the guillemot. It is very destructive and must be used with great moderation. A third method of fowling is *omanfleyg*. The fowlers row in to the cliffs in boats and startle the birds. Panic ensues, and hundreds of birds fly from the ledges to dive into the sea and are caught in nets on the way down. . . . Bird-catching on the cliffs is not without its inconveniences. The sun sometimes becomes unbearable, the fowler is often quite covered with guano, and is troubled with bird-lice. Exertion and excitement, however, make him oblivious of all this. . . . The fowling-season for the puffin and guillemot begins about the middle of June and finishes at the end of August. . . . In recent years the fowlers have begun to use floating bird-traps.'

These floating traps consist of wooden rafts anchored in the assembly places, bays, and harbours near the breeding-cliffs of the auks, which like to rest on logs, driftwood, etc., floating on the sea. The surface of a raft is laid out with numbers of hair- or wire-nooses and snares, in which the auks become entangled.

The first to be captured struggles, thus arousing the curiosity of spectators, which draw close and themselves become snared. The self-trapping noose is a very old device, and was in use on St Kilda, as I shall presently relate.



One June day I watched an Icelandic fowler using a *fleygustong* on the volcanic stack of Bjarnerey, one of the off-islets of the Westmann group. The sheer sides of this rock were plastered with nesting guillemots, razorbills, kittiwakes, and fulmars. It was a steep climb, but with the aid of ropes lowered by the cragsmen our party reached the grassy top, which is the bowl of an extinct volcano containing an immense puffinry. Here was a comfortable wooden hut with kitchen and sleeping quarters for six fowlers, who spend some weeks in May collecting the eggs of the cliff birds, and in July, when the young auks are well grown, the adult puffins are *fleyged.* It was not quite time to begin the *fleyging*, and we had really come to shear the 150 sheep which graze Bjarnerey. But a demonstration was arranged for our benefit. The fowler crawled towards the cliff edge where thousands of puffins were gathered in their usual summer afternoon assemblies. He lay flat among them, his *fleygustong* stretched along the grass in line with his body. His left hand gripped the end, his right held the shaft about three feet from the end. When a puffin flew close over his head the *fleygustong* was levered into the air and captured the bird neatly in the loose string net.

The spectators applauded each successful throw, and were in tears of laughter when the fowler, with a play of politeness and apology towards the birds, gently set his victim free, who waddled and tumbled towards the cliffs with what appeared to us to be backward glances of disgust and contempt.

Early in July of 1936 I found myself with a friend in the Faroes, and tried the *fleygustong* above the thousand-foot-high bird cliffs of Hestur Island. The men of Hestur held me by a rope and instructed me to lean well out into space, with my feet in a bird burrow, holding the net on the windward side, flat against the cliff. In this position it is easier to fling the net *downwind* upon the flying bird, as it always approaches the land upwind. With a little practice I achieved the trick of sweeping at the circling puffins, holding the shaft of the *fleygustong* so that the end pressed against the earth and gave my throw additional leverage and strength. Needless to say I caught nothing at first; and nobody was more surprised than I when, making a casual pass at a fulmar, I found it in the net.

On 3rd July I watched young Carl Niclasen *fleyging* puffins from a ledge on the thousand-foot-high cliffs of the neighbouring island of Koltur. His net flew out as gracefully as the crosse of an expert lacrosse player fielding the ball. There were no misses. As he caught each puffin he necked it and threw it behind him. When he had taken two hundred he stopped and brought them in four journeys to the top of the cliffs, in bundles of fifty, each tied in a great ruff around his neck in order to leave his hands free for climbing.

His cousin Sofus, who had been a spectator with me, insisted that it was not cruel to kill adult puffins at this time of the year, because 'there are seven adult puffins to every hole containing one young one. Imagine how difficult for the fowler to catch in his net all the seven adult puffins to each hole. It is not possible. So always there are some big ones left to feed the little ones. Otherwise, if for every pair of adult puffins netted one young bird die of hunger, puffins soon perish altogether in Faroe.'

The origin of this fairy-tale has some slight foundation in fact. From midsummer onwards, as we have seen, non-breeding adults visit the colony and mingle with breeding birds, so that it is true that there are more than two adults to each chick, and this proportion may be increased by the natural mortality among the nestlings, although there is no evidence that this death-rate is high, or even as high as the normal mortality from all causes of the adults. At this season there may be and probably are as many as four adults to each chick; but as yet we have no evidence that the unoccupied or surplus adults feed unrelated chicks. Non-breeders do not carry fish ashore; nor is it proven that an adult, having lost its chick at any earlier stage before desertion, would feed an alien chick of the same age occasionally. But we should keep an open mind and a keen look-out in these matters. It has been proved that guillemots will feed and mother chicks other than their own. Selous recorded this fostering; we have seen and recorded it ourselves. 'The guillemot,' Selous wrote, 'we will say, upon seeing a young bird which, by calling up memories, takes the place of its own, becomes, in imagination, its parent—so that the sympathy it shows for it is not wider than that between parent and child.' The puffin with a mouthful of fish may well be proved (by some future observer using a system of colour marking individuals) to be as kindly and sympathetic, as the Faroese people believe to be the case, to a young chick which has become an orphan as the result of *fleyging* operations. To test this it would be necessary to observe the traffic of adults in a burrow containing such an orphan—a line of research which we did not find the opportunity to indulge in. However, in view of the natural desertion of the chick (a desertion which does not take place on land with the guillemot) by the adult puffin before fledging time, it does not seem likely that feeding by foster puffins would occur near the end of the breeding-season in July. We have noticed that fledgelings deserted by their parents will call in vain, presumably for food, for a day or so, but they are ignored by adults bringing fish to feed younger chicks. These calls of the naturally abandoned chick soon cease; it appears to grow insensible to hunger for a while—and we do not know what new physical rhythm may change and govern its actions, which are more instinctive than reasoning so early in life. Animals in moult or in the heat of the breeding-season may fast for long periods, as young seals do during their first moult; and eider ducks and shearwaters fast while incubating.

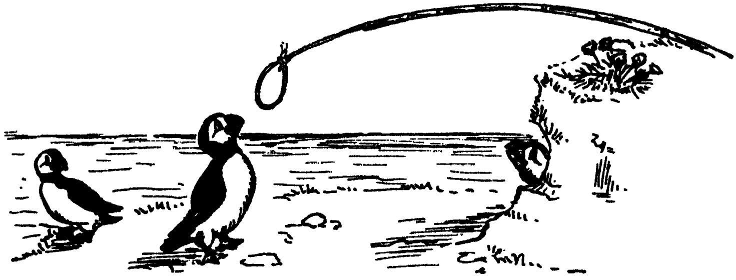
We must leave the chick, orphaned by the *fleygustong*, to its unknown fate in the burrows of Faroe cliffs. Whatever the answer to the seven adults to one chick theory may be, the fact remains that the exploited puffinries in the Faroes and Iceland suffer less diminution than the unexploited puffin colonies elsewhere. Traditional methods and regulations here have ensured through long experience the taking of a maximum crop without endangering the future of any one of the historic *fleyging* puffinries. Thus the right to take puffins at the best sites in the cliffs is usually in private ownership, belonging to certain landowners, shepherds, or fowlers, and is often hereditary; it is jealously guarded but may be delegated to others temporarily and the owner may fee it to a neighbour or permit a poorer man so many days' catching in return for other services.

Contrast this careful conservation with the story presented on the other side of the Atlantic where formerly puffins bred in countless thousands on Puffin Island on the Labrador coast (Ellitt Coues, 1861); here and on other islands hunters and visiting boatmen slaughtered them indiscriminately, reducing the puffins and gannets to insignificant numbers, and exterminating the great auk altogether.

In the British Isles puffins were taken for food and for baiting lobster-pots. At lonely St Kilda, farthest west of the Hebridean islands, the inhabitants were granted a special exemption from the Wild Birds Protection Acts to enable them to continue their traditional wildfowling upon which they depended for part of their food and rent. Various estimates of the numbers of puffins on St Kilda have been made, of which that of three millions by N. Mackenzie, minister there from 1829 to 1843, is considered by James Fisher, who knows the islands well at the present time, to be one of the most accurate. In 1876 at least 89,600 puffins were killed by St Kildans, less than one-thirtieth of Mackenzie's figure of 3,000,000. Allowing an annual summer increase of one fledgeling to every four adults, a take of 89,600 would represent about one-eighth of the seasonal increase.

Although somewhat hypothetical these figures are interesting, and may be compared with Rowan's estimate of 4,000,000 great shearwaters breeding at Nightingale Island, Tristan da Cunha, in the South Atlantic. Rowan considers that the annual depletion of this species by the Tristan islanders is not more than one per cent of the total adult population. The islanders used to collect 15,000 eggs and 20,000 chicks per annum, or 35,000 lives out of the summer increase of 1,000,000 (allowing, again, one fledged chick to each four adults); this represents about one-thirtieth, or 3·5 per cent, of the estimated seasonal increase. There is therefore less fear of exploitation of shearwaters by man at Tristan, where it still goes on, than there was of puffins by the St Kildans, who no longer trouble the sea-birds of their deserted home.

The *fleygustong* was apparently unknown at St Kilda; its place was taken by a fowling rod of about the same length. This rod was a softwood pole about thirteen feet long, with a pliant hazel or curved willow stick lashed to the thinner end. To this stick was bound a running noose of horse-hair plaited with gannet quills to give both that elasticity and stiffness which would keep it open yet pliable for the moment of slipping over the victim's head and drawing tight. This whip-like instrument was as efficient as the *fleygustong*, but could only be used on a bird at rest. It could be used to noose a sitting bird the length of the rod away from the fowler on an otherwise inaccessible cliff. When stalking puffins the fowler held the rod in the air or, more often, pushed the rod along the ground (as we did our hooked bamboo), for which purpose the piece of hazel or willow was curved so as to slide easily and keep the noose in the air. At the right second the fowler, with a twist of the wrist, flicked the snare over the head of the puffin and pulled the rod towards him, trying to disturb the spectator puffins as little as possible.



Another method of catching puffins at St Kilda was to anchor a length of rope, to which were attached up to forty nooses, upon a favourite rock or piece of ground used by the puffins for their daily assemblies. Intense curiosity would lead first one and then another to toy with the nooses, and soon they would become entangled—as already described for the floating rafts in the Faroes. The flapping of the first caught attracted others who settled closer to see what the fuss was about. These would also run foul of the nooses, and finding themselves too close to trapped neighbours would begin fighting. A fight, as we have seen, simply encouraged more spectators and busybodies. The St Kildans profited by this inquisitiveness and sociability of the puffins, which caught themselves by the dozen and score while the fowler sat comfortably on a distant rock, idle and amused by the spectacle, or for an hour or two went hunting with the long rod, in the confident expectation of finding a good haul in his anchored snare on his return.

According to Kearton, who visited St Kilda in 1896, and from whom we have taken the description of these St Kildan engines of the fowler's art, the puffins were 'plucked, split open like kippers, cured, and hung up to dry on strings stretched across the cottages; and whenever a native feels hungry he simply pulls one down from the line and flings it on the fire to grill, and forthwith has his lunch without the aid of knife, fork, plate, or napkin.' Elsewhere puffins were cured or preserved by smoking in barrels over burning peat—this I have watched in the Westmann Islands; or by salting in brine or wind-drying in *skeos* or *cletts* (slatted wooden sheds or unmortared stone huts)—the last two processes at the present time in the Faroes, and formerly at St Kilda.

St Kilda was evacuated by its human population in 1930. Since that year there has been no appreciable human predation of its millions of sea-birds; but there is no evidence that the puffins have increased, or decreased, as a result. To-day they still darken the sky as they did nearly three hundred years ago when Martin Martin made his immortal visit, and referred to the puffin as the 'Bowger.'

In many other islands of Scotland puffins were taken for food and feathers: at Foula in Shetland, at Berneray and Mingulay at the southern extremity of the Outer Hebrides, at Ailsa Craig in the Firth of Forth (since 1853), where Andrew Girvan killed 1,200 puffins with a pole in one day in 1900. And the same story of the taking of puffins for food up to the end of the last century will meet the explorer of local history in Ireland, the Isle of Man, Wales, and south-west England.

In Pembrokeshire they were taken in fishing-nets hung on short stakes along the slopes of the cliffs among or below the burrows, and used for food or for baiting lobster-pots. George Owen in his *Description of Penbrokeshire* (1603) describes the small islands as the 'chiefe nurserie' of the sea-birds which 'are ripe about midsummer, at which time they become flushe (flush or fledged), and are taken being readye to forsake their nestes.' He specially mentions 'the Puffine, a bird in all respectes bredd of byrdes of his kinde layeing egges fethered and flieing with other birdes in the ayre, and yet is reputed to be fishe, the reason I cannot learne. But if I were so ceremoniouse as to refrayne fleshe at seasons, I should hardely adventure to eate this fowle for fishe, yt is a water fowle lesser than the ducke and lardger than the teale, footed and beaked like vnto them and breedeth on the Iland of St Dauids and other like places.'

The same story is told in Richard Carew's *Survey of Cornwall* (1602): 'The Puffyn hatcheth in holes in the Cliffe, whose young ones are thence ferretted out, being exceeding fat, kept salted, and reputed for fish as coming nearest thereto in their taste.'

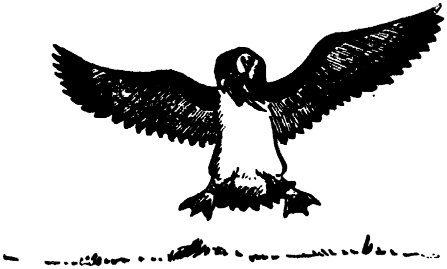
Everywhere man could catch the puffin it was formerly taken for food, from Labrador and the arctic, to its southernmost European breeding-grounds on the coasts of France and the Channel Islands. Breton fishermen were keen hunters of the auks, and at the present time still help themselves when they visit puffinries on remote British islets—in Pembrokeshire, Ireland, and Scotland—on their long crayfish and lobster fishing voyages off the west coasts. They are fond of eating the *macareux moine* as it is called in French (the French word *puffin* means shearwater), and will shoot them at sea, or go ashore at night and pull them out of their burrows. This custom of raiding the sea-bird colonies is still known as *barbeloting* in the Channel Islands, where it is now forbidden. Probably the word is derived from the French *barbelé*, meaning 'barbed,' and associated with the practice of hunting them with pointed or barbed instruments for extracting them from the burrows (a rather diabolical screwing instrument was formerly used on the Pembrokeshire islands for twisting the fur of a rabbit underground and drawing it forth, and it would the more easily pull out, by a grip of screwed-up skin and feathers, the burrowing birds). The local name of the puffin in the bailiwick of Guernsey (which includes Alderney, Sark, Herm, and Jethou, its principal breeding-places in the Channel Islands) is in fact *barbelote* (colloquial name in Spain, *barbeloute*). In Jersey the bird is known as 'Un Poffin'—a name doubtless derived from old Norman-Latin, and converted into the insular Norman-French patois which is spoken by Jersey farmers and fishermen.

As we review the evidence in this and the preceding chapter it begins to be clear that of all the enemies of the puffin, man, directly or indirectly, has been the most formidable in bringing about the world decrease of the bird in the southern part of its range. In the thinly populated Faroes, Iceland, Greenland, and St Kilda resident man remained a natural and unimportant predator in equilibrium with his prey; at the present time it is doubtful if the colonies of puffins in these islands have decreased at all, and it is almost certain that they have not increased either. Perhaps, as the islanders tend more and more to depend on imported tinned and chilled meats, the sea-bird fowling will die out, and with it the automatic control of the predators of the puffins—the larger gulls. In effect the puffins and all other sea-birds will be unmolested by man; then the gulls, artificially stimulated by man-made sources of food in autumn and winter and increasing thereby in numbers, will breed the more successfully for an assured supply in the summer of the eggs, young, and even adults of the smaller sea-birds: puffins, razorbills, guillemots, little auks, shearwaters, terns, and kittiwakes, for as long as that supply lasts.

We have seen that this situation already exists on several islands where puffins breed which are kept as sanctuaries for sea-birds. Indiscriminate protection in a nature reserve may not be the best policy after all. At Skokholm the little owl, artificially introduced into Britain, is often quoted as a bad example of man's interference with nature, since it preys there largely upon the storm-petrel, killing this pleasant little bird wantonly and hoarding the carcasses without eating them afterwards; it is believed to be slowly reducing the storm-petrel population at Skokholm, but it is wary and difficult to shoot. Puffins too, as already noted, are declining in numbers at Skokholm, although this has not yet been proved to be due to the large numbers of predatory gulls (in 1950 there were breeding at Skokholm: 550 pairs of herring-gulls, 350 pairs of lesser black-backs, and 64 pairs of great gulls).

It has not been possible to measure accurately the effect of pollution of the sea by waste oil discharged from tankers, but it must be considerable. The principal sufferers are the surface-swimming diving birds, those species, such as the puffin, guillemot, and razorbill, which swim more than they fly, and feed and migrate over the temperate North Atlantic which is the ocean most densely used by the world's tanker tonnage. Thousands of these auks are killed by the foul tarry slime of tankers' bilges; they die slowly and in great misery. Their suffering is a disgraceful example of man's inhumanity to his fellow creatures; for the remedy is in the hands of man, the inventor of the expensive atom bomb who is prepared to use this to cause more death and destruction, but who will not enforce the use of an earlier invention, the inexpensive oil separator, which would absorb profitably the residues of the tankers and keep the sea sweet for bird and man alike.

In the succeeding pages describing the distribution of the puffin we show that the decline is everywhere evident in the temperate latitudes, but the only positive reasons given are man's direct attacks in the form of battues, and indirectly by the introduction of rats. Probably, in spite of what has been written above, the predation of gulls, spectacular to watch as it is, is less significant than we have made it appear, except in the smaller colonies of puffins occupied by large numbers of gulls. It may be that one of the causes of the more recent fall in the world population of the two southern races of the puffin is a climatic one: the amelioration of the North Atlantic climate may be bringing about a northward shift of puffin population, through the migration of the puffin's food supplies.



APPENDIX I

DISTRIBUTION

Puffins belong to the family Alcidae *of the sub-order* Alcae, *or auks, which are marine members of the numerous order known as* Charadriiformes, *an order containing the waders, gulls, terns, and auks. Auks are of diving habits, and confined strictly to salt water and to the northern hemisphere.*

The international or scientific name of the subject of this book is *Fratercula arctica* (Linnaeus), so named by Linnaeus in his famous *Systema Naturae*, 1758.[1] It is the only puffin breeding in the North Atlantic, and it has been divided into three races or subspecies: the large (and large-billed) *naumanni*, confined to northern Greenland, Spitsbergen, Novaya Zemlya, and Jan Mayen (but on the last island the bird is variable and intermediate between *naumanni* and *arctica*); the intermediate or Atlantic puffin *arctica* of eastern Canada, Maine, southern Greenland, Iceland, Bear Island, and Norway; and the small southern or European form, *grabae* (first separated by Brehm in 1831 under the name of *Mormon grabae*, in the Faroes), covering the Faroes, the British and Channel Islands, France, and southern islands of Scandinavia.

The only other puffins in the world are the closely related horned puffin, *Fratercula corniculata*, breeding from islands in the Bering Sea south to Forrester Island, Alaska; and the weird-looking tufted puffin, *Lunda cirrhata*, which is found from northern Alaska and north-eastern Siberia south to the Santa Barbara Islands, California, and to Japan.

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[1] Pt. I, p. 30: 'Habitat in rupibus & praecipitis montium maris atlantici, praesertim in insulis.'

The horned puffin is slightly larger than our bird, but has similar black-and-white markings and a typical *Fratercula* beak, although the colours here are chiefly yellow with a bright red tip and rictal rosette. The horn is a small pointed wattle above the eye and takes the place of the leathery triangle of our bird; it can be raised when this species is excited during the breeding-season.

The tufted puffin is larger still, with a yellow-green, red-tipped bill, and during the summer there is an amazing dense ram's-horn tuft of fine cinnamon plumes sprouting from behind each light goatish eye. The face is white, the rest of the plumage sooty, the legs coral. In winter the plumes and the white mask vanish. The juvenile looks like a dusky edition of our adolescent puffin.

Both Pacific puffins are eagerly hunted for food by the Eskimoes, the Aleuts, and the Siberian natives, with the aid of long-handled string hoop-nets.

Some Measurements of *Fratercula arctica* in Millimetres:[1]

Race	*Locality*	*Sex*	*Wing (straight)*	*Greatest Length of bill*	*Greatest Depth of bill*
naumanni	(Spitsbergen)	Males (summer)	180–193	50–60	42–50
arctica	(N. Norway, Iceland, N. America)	Males (summer)	158–176	46–55	39–45
grabae	(Brit. Isles, Faroes, France)	Males (summer)	153–166	42–50	35–38
,,	,,	Females (summer)	148–165	43–48	34–38
,,	,,	Unsexed (1st winter)	138–148	31–37	18–20
,,	(Skokholm)	18 adults unsexed, summer	148–167		

According to Salomonsen, dwarf-mutants occur in the two larger subspecies, because the genetic base of the size is rather unstable. It is not, however, certain that these dwarfs are not 'lost' or abmigrated individuals of *grabae* which have wandered into the northern puffinries, where they were obtained.

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[1] From the *Handbook of British Birds*, vol. 5; Salomonsen, *The Atlantic Alcidae*; and Skokholm Bird Observatory Records, 1952.

For many of the detailed notes on distribution which follow I have to thank James Fisher, who has made a special study of the geographical distribution of North Atlantic sea-birds.

F. a. naumanni (Map, page 179)

The robust *Fratercula arctica naumanni*, a truly arctic puffin, uses natural tunnels in lava rocks and frost-splintered shale in north-western Greenland, where it is found from the uttermost inhabited (Thule) region of Smith Sound to the west end of Melville Bay. It is abundant in suitable cliffs at Spitsbergen and on the western faces of the Novaya Zemlya islands. It has been seen off the coasts of east Greenland and Franz Josef Land. How far south it travels in winter is not known—none or few have been ringed—but as a breeder it seems to coincide with the medium-sized *F. a. arctica* on Jan Mayen, where a series of measurements of nesting adults covers the extremes of both subspecies.

F. a. arctica (Map, page 179)

Besides Jan Mayen *F. a. arctica* ranges in the breeding-season between Melville Bay and Cape Farewell in West Greenland, and along the coast of Labrador (not more than a dozen stations), where its numbers are but a shadow of their former density; on the coasts of Newfoundland there are colonies on Funk Island (reduced to 1,000 pairs by 1945), Little Fogo (12 pairs, 1945), Wadham Islands (2,500 pairs, 1945), Cape Freels-Bonavista area (850 pairs, 1945), Bacalieu Island (3,500 pairs, 1941), Witless Bay Islands (1,500 pairs, 1942), and a tiny colony exists in the Bay of St John on the west coast (10 pairs, 1944); on Perroquet Island, near Belle Isle, the bird artist Audubon in 1883 found 'half the puffins in the world assembled,' but H. F. Lewis in 1940 found only 50,000 puffins; westwards along this Quebec coast the St Mary Islands had 6,000 and Wolf Bay 9,000 puffins in 1940; a few pairs may linger in the Mingan Islands; at Betchouane in the Seven Islands Lewis saw 750 puffins in 1940; and there are still colonies on cliffs on Anticosti Island, on Byron Island, and Bird Rock in the Magdalen group. The southernmost colonies on the American side of the Atlantic now appear to be: Machias

Seal Island (lying near Grand Manan Island, Bay of Fundy, and declared a bird reserve by Canada), with a population of puffins estimated to have increased from 30 in 1883 to 700 pairs by 1940, and on Matinicus Rock, off Penobscot Bay, Maine (about 40 pairs in 1946), which is therefore the only known colony in the United States to-day. Nowhere on the western shores of the temperate Atlantic is the puffin abundant to-day, although it was so, and probably bred on many other islands, before the white colonists from Europe settled in numbers there and began to slaughter sea-birds indiscriminately. They exterminated the great auk and the Labrador duck, and decimated the terns, the gannets, and the auks, to say nothing of the immense herds of seals. The appearance of 'civilized' man in America was, in fact, the appearance of death and racial destruction for many of the fine large species which had hitherto lived in harmony or equilibrium with the native redskin and Eskimo, themselves threatened and sometimes destroyed in the white invasion. However, it is satisfactory to report that, since certain islands and bird-cliffs have become breeding sanctuaries protected by law, an appreciable increase of the puffin numbers in Canada has been noticed. But hunters still shoot them: two ringed at St Kilda were shot here in the following winter (page 173).

The story of *F. a. arctica* in Iceland is very different. Here, after centuries of controlled 'farming' of the species, it is still as abundant as ever. The Iceland puffin harvest is discussed on page 142 of this book. Grimsey, an island on the north coast subject to volcanic disturbances, has usually yielded 8,000 puffins annually; the Westmann Islands about 50,000; and there are other worked puffinries (*lundeyjar*) on islands right around the coast of Iceland. The burrows are largely in soil, since the ground is seldom frozen late in the spring.

On Bear Island, between Norway and Spitsbergen, where *F. a. arctica* is the breeding subspecies, the holes are deep in rock crevices, as in Jan Mayen and Spitsbergen. The puffin is an early breeder and cannot wait to dig the ground which is not unfrozen until June. *F. a. arctica* is said to be largest (approaching very close to *F. a. naumanni*) on the north coast of Norway (near North Cape and Hornöy) and on the Murmansk cliffs where there are a few colonies, notably in the Ainowski Islands near Petsamo. The subspecies is a more normal size elsewhere in Norway where *arctica* ranges along the west coast (a colony of 120,000 at Vesteraalen in 1940) as far south as Bremnes, south of Bergen, where it mingles with, and cannot be distinguished from, *grabae*.

F. a. grabae (Map, page 179)

It is curious that the smallest puffin subspecies, *grabae*, is found as far north as the Faroes, its type locality, in the same latitude as *arctica* in Norway; but so it is, and this small race also covers the rest of European breeding-stations, including the British Isles and some vestigial colonies in the Skagerrak. Separatists among British taxonomists, however, declare that the Shetland and Orkney puffins are larger than *grabae* and half-way to *arctica*, and therefore larger than the Faroe puffins living much farther north! We must leave the final decision, if there is one, to the museum worker. Probably a more extensive series of measurements and weights would establish a more satisfactory correlation between the size of the three (or more) subspecies and their latitudinal range. As it is there is overlap in measurements between the medium and the two extremes, which makes it difficult to separate *arctica* from *naumanni*, or from *grabae*; all we can say with certainty is that the smallest *naumanni* is always larger than the largest *grabae*.

K. Williamson summarizes the status of the puffin in the Faroes in his book *The Atlantic Islands*. On the westernmost island of Mykines the average harvest of puffins is 30,000, but in a good year may be 60,000–90,000. On Nolsoy the figure is 20,000, Kunoy 13,000, Koltur 8,000, and large numbers are taken on the other islands, especially in the north-east—Vidoy, Bordoy, Svinoy, Fugloy. The fowlers on Vidoy claim the record for any one season, of 120,000 puffins taken. According to J. F. Jacobsen the best *fuglabjerg* (bird-mountains) are all on the west side of the islands of Suderoy, Stora and Litla Dimon, Skuvoy, Hestur, Koltur, Vagar, and Mykines. On a fine day at Mykines nearly 10,000 puffins were *fleyged*, 900 by one man.

In Norway the chief northerly breeding-station of *grabae* was the island of Rott, near Stavanger; it contained 2,000 puffins in 1919. By 1940 the colony was completely wiped out as a result of incessant persecution by rats and amateur fowlers. This left only a few small colonies in southern Norway, of which that on Utsira (55 pairs, 1952) is the largest. On the Sösteröyene Skerries in the Skagerrak a colony of about 20 pairs (in 1944) has been exterminated. Two other islets in the Skagerrak, close to the Swedish shore, may still harbour breeding puffins: Stora Knappen, 6 pairs in 1944 (none in 1951), and Soteskär, reduced to about 6 pairs in 1951.

In the rest of Europe, excluding the British Isles, puffins formerly bred on Heligoland; about 1835 one or two pairs which inhabited a cone-shaped column of rock about thirty feet high there were netted by an old shoemaker, who became the first bird-stuffer on the island; and although puffins have been seen almost every spring since, among the guillemots which frequent Heligoland, none has been found breeding there again.

Passing south-westwards from Heligoland there are no suitable cliffs or rocky islands along the coast of Europe until we reach the white walls of the English Channel; but puffins do not breed, and may never have bred, in French chalk. The first colonies at the present time are in the Channel Islands, of which by far the largest (about 50,000 pairs) is that on Burhou, described earlier in this book. Dobson enumerates the other colonies: a few pairs in very small colonies on the southern cliffs and stacks of Alderney; colonies of 100 and 200 pairs on the islets of the Humps, north of Herm; on Herm and Jethou; 750 pairs on the Stack of Sark, and a small colony on the Moie de Mouton, cliffs of Sark; and a few pairs in Jersey—I have counted 25 pairs on the western part of the north cliffs there in 1950.

In France the principal colony is on the island of Rouzic, where the first French gannetry was established in 1939. Rouzic is the most northerly of the Sept Îles, Côtes-du-Nord, Brittany, an archipelago which is now a nature reserve under the French League for the Protection of Birds. On 13th June 1949 I estimated at least 2,500 pairs of puffins breeding on Rouzic, and there is a smaller colony on Île Malban. Puffins are numerous at sea all along the rocky north coast of Brittany, and there are smaller colonies as far as the extreme point of land at Île d'Ouessant and south to the Îles de Glénan.

BRITISH ISLES (Map, page 178)

Scotland. The distribution of the puffin in the British Isles is now fairly well worked out, thanks to the activity of bird watchers. Our survey naturally commences with the Shetlands, where the puffin is abundant. Here Edmund Selous made his discursive but shrewd and accurate study of the bird. The chief puffinries are at Hermaness, Out Skerries, Noss, Bressay, Papa Stour, North Roe, Fitful Head, Esha Ness, and Sumburgh Head. Great numbers nest on Fair Isle, and on lonely Foula there is probably the largest puffinry, next to that of St Kilda, in the British Isles. Thousands upon thousands of 'Tammy Norries,' which is the colloquial name in northern Scotland, blacken the sky about the 1,220-foot-high cliffs of the Kame on the west side of Foula.

In the Orkneys, wherever there are suitable cliffs and small islands, the puffin breeds in large communities, inhabiting the cliffs of Orkney mainland, and on Hoy, Westray, Eday, Shapinsay, Stronsay, etc. Far to the west of Orkney is the isolated stack of Sule Skerry, where H. W. Robinson secured longevity records; it has a lighthouse and belongs to Orkney parochially and politically, and is quite covered with occupied puffin burrows. But Sule Stack, four and a half miles to the south-west, has none on its bare rock face, which is full with breeding gannets for most of the year.

At North Rona, forty miles from Cape Wrath, puffins swarm on this uninhabited northernmost turf-covered outpost of the Outer Hebrides. Near by is the gannetry of Sula Sgeir, where Robert Atkinson saw only a few puffins in 1939—there were not many suitable holes. St Kilda and its gigantic assemblies of sea-birds has already been described as the greatest puffinry of all, containing between one and three millions of puffins.

Rockall, a solitary rock 70 feet high with a circumference at base of 250 feet lying nearly two hundred miles west of St Kilda, has been the subject of much speculation and very rare landings in the past. At one time it was believed to be the breeding-place of several sea-birds, including puffins. When Stephen Marchant and I visited the Rockall fishing banks in the Fleetwood trawler *Clothilde* from 19th to 27th June 1948 we were often in sight of the rock, and once within three hundred yards. But there was no sign of nesting puffins—the rock was bare of earth or vegetation—and no burrow visible. Our trawler skipper informed us that in heavy weather the sea sweeps right over the summit, a frequent occurrence even in summer. The only birds we saw resting on Rockall at that season were two gannets—they were not nesting. In the whole of our stay on the Rockall fishing bank we saw only nine puffins, of which one was in winter or immature plumage.

Probably the puffinry next largest in the Hebrides to St Kilda is that of the Shiant Isles in the Minch. Here in 1887 the naturalists Harvie-Brown and Buckley saw 'myriads,' and were impressed enough to estimate that the puffin must be the most abundant species of rock-bird on the west coast of Scotland. Later visitors to the Shiants have found it much less numerous, but it is still abundant in spite of plagues of giant rats and gone-wild cats. Berneray and Mingulay at the south end of the Outer Hebrides have always had large puffinries, where in the past the islanders trapped, salted, and stored many puffins for the winter. At the other end of the Outer Hebrides the isolated Flannan Isles puffins are plentiful; Robert Atkinson in 1937 found that at his approach they 'buzzed away as thick as dungflies from a cowpat. The ground snored and grunted with them, they dashed out from underfoot and bundled themselves away, often hitting the ground and overturning all of a tumble in their haste.'

Harvie-Brown in 1881 found 'innumerable' puffins on Haskeir, a rock west of North Uist; they were tunnelling deep into sea-pink hummocks and under loose stones: 'with a spade or pick hundreds of eggs could, we believe, easily be gathered.' James Fisher in May 1949, however, found only a very few, apparently breeding, although he may have been there on one of the unaccountable 'off' days which we have shown to occur in puffinries in May.

Other Hebridean puffinries exist on many small Gaelic-named rocks and islets; notably on the Ascrib Isles and Fladda-chuain on the north-west coast of Skye; on Canna and its satellite Sanday; on Rhum, Muck, the Treshnish Isles, and the Mull of Oa (Islay). There is a puffinry on Sanda, Mull of Kintyre, within sight of Rathlin and the Ulster coast.

In the Firth of Clyde Ailsa Craig has a traditional puffinry, already mentioned as much reduced by rats. In 1696 William Abercrummie describes 'sea-fowls, which are brought from Ailsa . . . called Albanacks or Ailsa Cocks, and Tarnathans, of which there is so great a multitude about that Isle, that when, by a shot of a piece, they are put upon the wing, they will darken the heavens above the spectators.' James Fisher, who has explored the literature of Ailsa Craig and many times visited the island, thinks that the 'Albanacks' were undoubtedly puffins. They bred in great numbers until the rats came ashore in 1889. R. Gray (1871) tells a fabulous tale of how 'on the upper slopes of the Craig very large numbers are also found breeding in burrows of their own making, which resemble rabbit-holes. From these strongholds it is almost impossible to dodge them, except by a dog trained for the work. On one occasion, many years ago [so long ago, we presume, that the recollection must be well wrapped up with the fictions of the imagination!], I accompanied the keeper, who owned a dog of this kind, to a Puffin warren, near the summit of the island, and I was greatly diverted at seeing the little fellow, after having pushed his way along the dark passages, shuffle out of a burrow with half a dozen Puffins dangling from various parts of his body. Like a bull-dog, an angry Puffin never thinks of quitting its hold—a habit which makes the shaggy coat of a Skye-terrier extremely serviceable as a bait.' Unfortunately for the narrator of this shaggy dog tale, the average puffin burrow will barely admit the thickness of a man's arm below the elbow, and certainly could not give entrance or exit to a terrier with half a dozen puffins clinging to it!

Hansard, for 20th May 1924, shows that questions were asked in Parliament about the rats attacking the sea-birds of Ailsa, and in the following winter the Royal Society for the Protection of Birds paid for a rat-poisoning campaign. This killed bucket-loads of rats, and the puffins had a temporary respite. But the decline has continued and now there are only a few score pairs left, chiefly in the inaccessible cliffs.

The mainland coasts of Scotland support only a few colonies, the largest in Sutherland, near Cape Wrath. Clomore Head, five miles east from the Cape, has many thousands, and there are strong colonies at Cape Wrath, Far-Out Head, Whiten Head, and about a thousand on Eilean Bulgach, south-west of Cape Wrath. Handa Island, near Scourie, is noted for a bird cliff 'one league long' and full of puffins. Formerly puffins nested in the Summer Isles; Fisher, 1952, found none, even on the outermost, Glasleac-beg. Continuing down the whole of the west coast, there are no large or even small puffinries recently recorded until the farthest south-west point of the mainland is reached at the Mull of Galloway, where in 1948, passing the bird-whitened cliffs in a trawler bound for Rockall, we saw flights of puffins heading for the wild precipices above which lay peaceful farm-lands.

There may still be a few puffins in Luce Bay to the east, in company with the gannets which breed on the Scare or Scaur Rocks.

On the east side of Scotland puffins are much scarcer, and there are no large colonies. Scattered pairs nest in the highest cliffs of some of the Caithness headlands, where there are two fair puffinries, at Duncansby and Noss Heads. The same can be said of a few sheer and inaccessible cliffs in Banff, Aberdeen, Kincardine, and Angus shires. In the Firth of Forth there are only three colonies; Isle of May, never more than fifty pairs; Bass Rock, maximum fifty pairs; and Craigleith, about twenty-five pairs. St Abb's Head in Berwickshire is an old site, but has never contained many pairs. A few may still breed there.

England and Wales. Continuing south along the eastern shore the first colony is the traditional one of the Farne Islands, which John Ray visited in 1671 and Thomas Pennant in 1769. Here puffins, locally known as 'Tom Noddies,' were not plentiful in the last century, probably due to persecution by marauding fishermen. But under protection at the present time they have increased; this puffinry may be 2,000 pairs or more strong to-day.

There is a well-known colony in Yorkshire, on the chalk cliffs between Speeton and Flamborough Head, where puffins seem to have remained unchanged in numbers since Ray mentioned them after his 1661 and 1671 visits. Many baskets of eggs of the other auks and of gulls are, or were, taken by cragsmen in their traditional raids in early summer, but the puffins were safe in burrows on the turf ledges and in chalk holes.

Southwards there are no other colonies on the east coast, and few enough on the south. Like the red-billed crow, and about the same time, early in the nineteenth century, the puffin ceased to nest in the chalk cliffs of Kent. A small colony survives near the Needles in the Isle of Wight, another in the cliffs near Swanage, and at Portland Bill in Dorset. Probably it has now deserted Berry Head in Devon, as well as all its ancient haunts in southern Cornwall.

Even in the Isles of Scilly the colonies are not anything like their former size. Thus Annet, which is a granite island comparable in size, and at one time in puffin population, with Burhou in the Channel Islands, is almost if not quite deserted. The late C. J. King, the Scilly naturalist, witnessed the decline of the Annet puffinry from thousands early in this century down to a few score, and put this melancholy state of affairs down to the unchecked increase in the great black-backed gull—in his letters to me. We have seen (page 141) that puffins paid the rent of these isles in 1337; and John Leland (1506–52) in his *Itinerarye* stated that 'puffines be taken in diuerse of these islettes.' At the present time Major A. A. Dorrien-Smith writes that there are only a few small colonies on certain of the eastern and western islets: 'Puffins are very low in numbers still, but I think increasing a little, but they are only in tens where they used to be in thousands. Very few lance or small fry fish about may be one cause of their diminution—I think a very likely one. Oil also kills a lot of puffins, razorbills, and guillemots.' The once alleged large colony on Round Island has never been seen by people living to-day.

The tale of the disappearance of the puffin is continued along the western coasts of Cornwall. None now breeds at Land's End or Godrevy Island (where John Ray, 1662, recorded 'great numbers'). But small colonies still exist on rocks and cliffs from Perranporth to Boscastle. The largest is on Lye Rock where on 20th April 1948 we estimated that some 2,000 were present, and found puffins on three other small islets near Boscastle; but a count in April would not be so reliable as one in June or early July.

The word 'Lundy' is, of course, Norse, meaning 'Island of Puffins.' Perry surveyed the puffin colony on Lundy Island in 1940. He found 3,500 pairs, a great change from the 'incredible number' which, with other auks, made 'the water beneath the cliffs, almost as far from land as the eye can reach, black with a multitude of the birds,' as seen fifty years earlier by D'Urban and Mathew. Rats are held responsible for the continued decrease of this puffinry, which Peter Davis tells me in 1952 was down to not more than 400 pairs; he suspects oil and rats as the most important causes of the decrease. Lundy is the only Devon site at present occupied.

Across the Bristol Channel is, or was, the small puffinry on Worms' Head off the Gower peninsula of Glamorgan. Recorded in 1848, it was reduced to a few pairs in 1907, and was last noted breeding in 1951.

Pembrokeshire holds more puffins than the whole of the rest of England and Wales. At least 50,000 pairs breed at Skomer (1952); from 1928 to 1940 there were 20,000 pairs at Skokholm; but there has been a marked decrease at Skokholm, and almost certainly a slight decrease at Skomer. Maximum numbers at both islands seem to have occurred about the time the farming fell into disuse there late in the last century, when the fields were abandoned to the burrowing puffins and shearwaters, when great gulls were scarce or absent, and oil pollution was almost unknown and certainly not talked of. On both islands albino puffins have been recorded: one at Skomer was for a long time in a glass case there.

We have already described the remarkable changes at Grassholm, from 'half a million' puffins in 1890 to a few pairs, not certainly breeding, in 1952—a change associated with a sudden increase at Skokholm early in the present century. Elsewhere there are only very small puffin colonies in Pembrokeshire: ten pairs in the cliffs, 1952, of rat-infested St Margaret's Isle, near Tenby; odd pairs in the limestone cliffs near St Govan's Head; the same on the North and Middle Bishop Rocks west of Ramsey Island, where it formerly bred in numbers (George Owen, 1605, called this place 'St Dauid's Iland'); and at one site between Fishguard and Cardigan. A few puffins are seen each year on the water under the rat-infested Cardigan Island off the Teify estuary, where the turf, now grazed by a flock of Soay sheep owned by the West Wales Field Society, shows signs of a large well-burrowed abandoned puffinry.

Another Cardiganshire site where breeding is not proved is the cliff near the Bird Rock, New Quay. Here, where the fulmar has settled to breed at last, a few puffins mingle with the guillemots floating on the water. Northwards across the sandy, shallow Cardigan Bay, the nearest colonies are in Carnarvonshire. The St Tudwal's Islands have been noted for their puffinries, first recorded by William Bingley who landed there in 1798. In 1903 H. E. Forrest found hundreds of thousands. James Fisher in 1935 considered that there were between ten and twenty thousand puffin holes, but not all were in use. None now breeds on Bardsey Island (although John Ray (1661) records 'Prestholm Puffins' there); but on the nearby islet of Ynys-gwylan-fawr on 30th April 1951 I found about 500 pairs of puffins breeding—this colony was described by O. V. Aplin in 1901, who saw an overflow on the headland opposite known as Trwyn y Penrhyn, but this was deserted in 1951. A small colony still exists in the north of Carnarvonshire at Great Orme's Head, first recorded by Thomas Pennant.

Across the strait from Great Orme's Head, Puffin Island or Priestholm, in Anglesey, was formerly, as its name implies, a vast puffinry. Pennant compared the puffin flocks here to 'swarms of bees for multitude.' In 1798, accordingly to Bingley, 'upwards of fifty acres of land there (were) literally covered with puffins.' Rats arrived from a wrecked ship in 1816–17 and reduced the rabbits and puffins so low as to make the island worthless to the tenant. At the present time only a few hundred pairs nest, and the island is dominated by gulls and the objectionable umbellifer, alexanders (*Smyrnium Olusatrum*). Elsewhere in Anglesey a few pairs breed near the South Stack lighthouse on Holyhead Island, and possibly on the Skerries rocks, north of Holyhead.

In the Isle of Man the puffin was known to be breeding abundantly on Calf Island, along with shearwaters. It has been said that when Ray and Willughby visited Man in 1660 they confused the young of the shearwater with that of the puffin, with the result that the Manx shearwater to this day is known as *Puffinus puffinus puffinus*. However, Canon Raven, in his book on John Ray, states that 'though Willughby's description of the young "Puffin of the Isle of Man" (*Puffinus puffinus*) obtained on the Calf is quoted, the account of the cliffs at the southern end of the isle and of the nocturnal habits and daytime solitude of the shearwater are plainly Ray's work. Nor is it fair to accuse him of confusing the birds then seen with those now called puffins. He found the shearwaters on the Calf of Man, named by the Manxmen "puffins," but when he visited Prestholm he distinctly separates "the puffins, so called there, which I take to be *Anas arctica clusii*," and does the same at Bardsey ("there builds the Prestholm puffin"). In the *Ornithology* the two species are widely and rightly separated, the puffin of to-day being grouped with the auks, the puffin of the Isle of Man with the shearwater supplied to him by Sir Thomas Browne.' None seems now to breed on the Calf, which is rat infested, and the only puffinries in Man to-day are very small ones—at Spanish Head and the Chasms. It is doubtful if the few pairs formerly breeding on Maughold Head now do so; the last seen there were carrying fish to burrows in 1946.

Ireland. On the east coast there is a traditional puffinry on the private island sanctuary of Lambay. Writing in the *Irish Naturalist's Journal* in 1907 Patterson observed that 'immense numbers breed' on the north and east sides, 'about 1,400 seen on the water around Lambay alone. They are known to vary their fish diet by an occasional young rabbit.' The last unique and obviously untrue statement makes us suspicious of the accuracy of Patterson's 'immense numbers.' In June 1939 we estimated that approximately 1,000 pairs of puffins were at Lambay; there are, by the way, rats on this well-farmed island. Farther to the south on the much smaller island of Ireland's Eye, which I visited on 13th June 1939, there was a puffinry of about the same size—1,000 pairs.

On the south Irish coast Great Saltee has about 3,000 pairs, in spite of rats; but there are no other known colonies until the islands of the south-west are reached, although some small ones may have been overlooked. There is a puffinry on High Island, and one on the Bull Rock, in the far west of Co. Cork. Great numbers breed in the Blasket Islands, the Skelligs, and Puffin Island, in Co. Kerry. In Co. Clare there are puffins on the stupendous cliffs of Moher; and in Galway small colonies may exist on the numerous little islands off the western headlands. In Co. Mayo Clare Island has a puffinry in its western cliffs, and there were at least 5,000 pairs on the Bills of Achill Island when R. S. R. Fitter visited this wild spot in 1939; while considerable numbers breed on the Stags of Broadhaven, and on cliffs and islands as far east as Balderg.

Co. Donegal has some of the largest puffinries in Ireland, such as those of Tormore, Aran and Tory Islands, and Horn Head; and there may be many small ones not generally known to ornithologists.

The only known Ulster colonies are on the great cliffs of Rathlin Island, but many of these are large; on the little Sheep Island, in sight of Rathlin; and on the cliffs of the Gobbins in Co. Down.

DISTRIBUTION IN WINTER

It has not been difficult to map out the breeding distribution, but of the range of the puffin at sea in winter we are much more uncertain. Although two St Kildan puffins, ringed as young in August 1939, were taken on the shores of Newfoundland in December of the same year, this is at present the only evidence we have that European puffins have crossed the Atlantic. However, very few young puffins have been ringed.

It is significant and remarkable that juvenile sea-birds, as we are discovering by ringing, may perform the longest migrations of their lives in their first winter. Young British-born kittiwakes have made the same journey to Newfoundland in their first winter, and a young fulmar, ringed at St Kilda on 17th July by James Fisher, has reached the Newfoundland Banks by 8th November of the same year. A Manx shearwater has reached Rio de Janeiro five months after it was hatched at Skokholm. Young gannets in their first winter travel farther south than the adults, and reach the coast of tropical West Africa for the first, and probably last, time in their long lives.

It is further significant that there is a definite concentration of puffins late in winter on the Newfoundland Banks, and in such numbers as to suggest that there may be an influx from the European side—as ringing has suggested. Rankin and Duffey show that puffins are present in small numbers on the Grand Bank of Newfoundland in early December, and throughout December, January, and February they increased and extended east until the farthest point was reached in the last days of February, and on 1st March—at 45° N. 45° W. On their next trip, made by these observers in April, the puffins had disappeared. There are few, but just enough, mid-Atlantic records (see map, page 179) to show that puffins are scattered over the whole of the North Atlantic along the main shipping lanes between the Newfoundland Banks and the British Isles in winter, but probably the isolated deep-sea records are those of migrating, rather than wintering, birds. It may well be that it is only the young puffins that wander across the Atlantic to an ancient traditional wintering area south-east of Newfoundland, which is known to be an ideal feeding-ground for many pelagic animals.

Normally the puffins of the American coast—*arctica* subspecies—are not seen regularly south of the Massachusetts shore in winter, although stray birds reach Long Island from time to time. The fortieth parallel is probably the southern limit of the puffin on the western shores of the North Atlantic.

On the European side, where the puffin is much more numerous, the winter range of the three subspecies has not been fully worked out, for lack of ringing and collecting. What happens to *naumanni* is a matter of conjecture, but it does not appear to move far south—at least there are no records. Schiöler mentions a series of puffins from south-west Greenland *which were flightless* (that is with moulted quills) in November (see Salomonsen, *The Atlantic Alcidae*). The puffins which frequent the waters of south Greenland, Iceland, and west of the Faroes at that season may be *naumanni*, but are more likely to be *arctica*. *Naumanni* may prove to be almost sedentary, living within a few hundred miles of the edge of the winter-frozen seas. Rockall is another feeding-ground in winter, probably of *arctica*, which Salomonsen says is recorded in winter from the Faroes, West Sweden, Danish waters (rare), and Germany (accidental). The movements of some young puffins in late autumn and winter are at present somewhat confusing; thus three ringed in North Britain have been recovered in Norway. These may have been gale-driven, and blown far out of their normal course and presumed southward route. One ringed in Brittany in July was found breeding in the Isles of Scilly two years later. Others, ringed as adults in the Pembrokeshire islands, have followed the normal observed autumn and winter movement and have been recovered southwards, in the Bay of Biscay.

This is the well-known migration, probably confined to the small subspecies *grabae*, south from the British Isles as far as the Azores and Madeira, and more rarely the Canary Islands; regularly to Morocco and through the Straits of Gibraltar to the Balearic Islands, where some remain so late in the spring as to be suspected (erroneously) of breeding there. Nor do they breed on the Berlengas Islands off Portugal, which I visited in 1939, although this was for long thought to be a probable nesting site. Puffins have been recorded as late as May in the Mediterranean; these must have been late-maturing birds, non-breeders for that year which would not return to their northern breeding-grounds until midsummer or the following spring. Puffins have reached the mainland coast of Italy, even of Dalmatia, in winter, and are regular visitors off the islands of Sicily, Sardinia, and Corsica.

During late autumn gales juvenile puffins, and rarely adults, may be blown far inland. There are inland records at this season for most of the west European countries, and even from Hungary. But most of all in the British Isles; and I have been sent live puffins for release on the Welsh coast, which were picked up in Nottingham (one) and London (one)! These inland appearances are, however, quite accidental, and there is no evidence of a regular overland migration of this essentially marine and pelagic species.

APPENDIX II

NUMBERS

How many puffins are there in the world? That is to say, how many *Fratercula arctica* are there in the North Atlantic and Arctic oceans and islands? From our survey of the distribution of the bird, is it possible to form even the roughest estimate? It is certainly very difficult. In the first place we have no definite round figures for the population of *naumanni* in the high arctic; is this subspecies in hundreds of thousands or in millions? If there are three millions of puffins at St Kilda surely there are as many *naumanni* in the whole of the arctic? An attempt to tabulate the estimates for each known puffinry in the world breaks down because of this lack of even approximate figures for the remoter colonies, a lack greatly accentuated by the habit of the puffin in concealing its nesting arrangements under the ground. The populations of some other species of sea-birds which nest in the open have been ascertained within a greater degree of accuracy. That of the North Atlantic gannet (*Sula Bassana*), for example, has been counted four times, with a comparatively small margin of probable error:

1913. 101,000 breeding adults. J. H. Gurney in *The Gannet*, London.

1935. 156,000 breeding adults. Wynne-Edwards, Lockley, and Salmon, *British Birds*, 29: 262–76.

1939. 165,600 breeding adults. Fisher and Vevers, *Jour. Anim. Ecol.*, 12: 173–213.

1949. *c.* 200,000 breeding adults. Fisher and Vevers, *Proc. X. Int. Orn. Congress*.

Fisher in his book on the fulmar concludes that over a million nests were occupied (up to 1949) by the Atlantic fulmar; and adds that 'I do not believe that the true figure, if ever determined, will prove to be many millions, or even several millions. Indeed, I would be surprised if it were as much as two millions, and would eat my hat (if I had one) if it were ten millions.' Perhaps with this precedent by a colleague I can risk a similar 'nod' at the world census of the puffin. From all sources the following appear to be the minimum figures:

Naumanni, not less than	500,000	breeding	adults
Arctica, in America	100,000	„	„
„ in Iceland	5,000,000	„	„
„ in Jan Mayen, Bear Island, Norway, etc.	500,000	„	„
Grabae, in Faroes	5,000,000	„	„
„ in British Isles	4,000,000	„	„
„ in France and Channel Isles	125,000	„	„
Grand total	15,225,000		

We are entitled to conclude that there were at least ten million puffins (*Fratercula arctica*) breeding in the middle of the twentieth century; there may be twenty, or even thirty million. It is also clear that the present figure is a reduction, probably a considerable one, on the population of one hundred years ago. But still the puffin remains one of, if not the, most numerous of sea-birds in the whole Atlantic.

APPENDIX III

SOME TIMES OF ARRIVAL AND DEPARTURE OF ADULT PUFFINS

(A) At Sule Skerry, west of Orkney Islands (*British Birds*, 27: 264).

Year	*First seen*	*Landed*	*Year*	*First seen*	*Landed*
1896	April 15	April 20	1902	April 9	April 18
1897	„ 14	„ 22	1907	„ 9	„ 16
1898	„ 8	„ 22	1931	„ 9	„ 16–18
1999	„ 7	„ 16	1932	„ 8	„ 16–18
1900	„ 12	„ 18	1933	„ 8	„ 16
1901	„ 10	„ 18			

(B) At Skokholm (*British Birds*, 27: 214, and Skokholm Records, 1947–52).

Year	*First seen on sea*	*First visitation on cliffs*	*Last seen on land*	*Last seen on sea*
1928	Mar. 28	April 4	Aug. 22	Sept. 7
1929	„ 25	„ 6	„ 16	„ 12
1930	„ 31	„ 8	„ 18	„ 10
1931	„ 25	„ 6	„ 15	„ 17
1932	„ 22	„ 4	„ 24	„ 18
1933	„ 29	„ 3	„ 26	„ 8
1947	„ 31	„ 10	„ 25	
1948	„ 28	„ 6	„ 16	
1949	„ 23	„ 10	„ 16	
1950	„ 31	„ 5	„ 22	
1951	Apr. 3	„ 12	„ 21	„ 13
1952	Mar. 26	„ 3	„ 24	

APPENDIX IV

SOME RECOVERIES OF PUFFINS WHERE RINGED

(*Ringed as Adults*)

Ring no.	*Where ringed*	*Date ringed*	*Date recovered*
3 birds	Sule Skerry, Orkney	May 1930	Summer 1932
AB646	„ „	June 1928	July 1935
2 birds	„ „	July 1929	„
CA426	„ „	June 1930	„
3 birds	„ „	June 1934	„
11 birds	„ „	June 1935	July 1936
8 birds	„ „	June 1936	May 1937
2 birds	„ „	„	July 1938
23 birds	„ „	May 1937	„
RW6468	Dunnet Head, Caithness	2.7.1935	23.6.1936
RS2338	Skokholm, Pembrokeshire	29.6.1933	14.6.1934
RX5052	„ „	19.7.1937	20.4.1939
AT3250	„ „	22.5.1946	30.6.1948
AT6601	„ „	2.6.1947	2.6.1948
AT6769	„ „	23.6.1947	12.6.1948
AT7241	„ „	29.6.1947	14.7.1948
AT7242	„ „	„	30.6.1948
AT7845	„ „	14.7.1947	5.7.1948
AV3088	„ „	11.6.1948	24.6.1949
AV3240	„ „	23.6.1948	19.7.1950
AV5566	„ „	8.7.1949	28.4.1950
AV5654	„ „	11.7.1949	„
3 birds	„ „	June 1948	June 1952
2 birds	„ „	Summer 1949	May 1952

At Bleik, Vesteraalen, Norway (after Holger Holgersen)

No. 41564 ringed 10.8.1941 recovered 23.7.1950

2 birds recovered where ringed after 8 years
5 „ „ „ 7 „
8 „ „ „ 6 „
13 „ „ „ 5 „
30 „ „ „ 4 „
8 „ „ „ 3 „
18 „ „ „ 2 „
15 „ „ „ 1 „

(*Ringed as Young*)

RV9441	Skokholm, Pembrokeshire	10.7.1935	11.7.1936
RW2532	St. Kilda, Scotland	4.8.1939	4.3.1940 (Hoy, Orkney)

SOME RECOVERIES OF RINGED PUFFINS ABROAD

Ring no.	*Age*	*Where ringed*	*Date*	*How and where recovered*	*Date*
RR5575	adult	Skomer, Pemb.	2.7.1928	Killed, Arcachon, France	Dec. 1929
	young	Sutherland	24.6.1927	Prov. Kristiansund, Norway	22.10.1927
D2682	adult	Sept Îles, Brittany	6.7.1934	Breeding Annet, Isles of Scilly	May 1936
RW8548	young	Farne Islands, Northumb.	28.6.1936	Haugesund, S. Norway	10.11.1936
RW7161	young	Farne Islands	12.7.1936	Flekkefjord, S. Norway	8.12.1936
RV4692	young	St Kilda, Scotland	10.8.1939	Shot. Herring Neck, N. Newfoundland	20.12.1939
RW3439	young	,,	4.8.1939	Bonavista Bay, Newfoundland	21.12.1939
AT7238	adult	Skokholm, Pemb.	28.6.1947	Dead. Bousin d' Arcachon, Gironde, France	18.2.1951
	adult	,,	18.7.1946	Oiled, Guernsey	9.10.1952

HOMING EXPERIMENT

RW7570 } Transported from Skokholm and experimentally released at Start
RW7573 } Point, S. Devon, on 18.6.1936: both returned by 23.6.1936.

APPENDIX V

SOME WEIGHTS AND MEASUREMENTS OF PUFFINS

olm Bird Observatory

Date	*Weight in grams*	*Wing straight mm.*	*Wing curved mm.*
1.6.1948	366·4		
22.4.1950	355·7		
24.5.1951	412·2		
24.4.1949		167	
14.4.1952	394·1	150	143
15.4.1952	418·4	159	153
	420·9	161	155
	352·9	158	154
	384·2	159	154
	340·3	151	145
	452·4	163	154
	371·1	157	151
	386·9	160	153
	411·4	158	153
	375·3	155	150
	380·9	163	156
	410·4		
	339·1	148	144
	338·3	151	142
	362·9	158	152
19.4.1952	432·6	158	150
	395·2	160	156

Young at Skomer, Pembrokeshire, about to fly

21.7.1952	292.9
	250·1
	258·5
	278·0
	271·3
	281·2

APPENDIX VI

A NOTE ON MOULT

Adults. Little is known of the moult of the adults. The autumn moult takes place much later than in other auks. Six birds from Spitsbergen, Iceland, Norway, in August have not commenced. Schiöler mentions a series of birds from south-west Greenland being *flightless in November.* A bird from south-west Greenland on 25th November which Salomonsen examined was in winter plumage, with scattered feather growth, the remaining plumage being very worn summer dress, the remiges old and faded; the bill was in moult, the appendages shed. A Swedish bird on 2nd December was in like condition. A specimen of *grabae* on 14th December had quite finished the body moult, but the primaries were still growing, this stage no doubt being the last of the moult—a stage of long duration which gave rise to the description of *F. a. meridionalis* (Jordans) from the Mediterranean, a quite untenable subspecies which turns out to be *grabae* in unfinished winter plumage! Two other birds in January-February had new fine remiges, growth complete. The autumn moult is therefore only partial; the spring moult is complete, the old remiges and rectrices not being moulted until the prenuptial moult in spring. This is a rare phenomenon, hitherto only found in a few species, such as the *colymbidae* or divers. In other auks the prenuptial moult is confined to head and neck.

Juveniles. The post-natal moult begins in July and finishes August to early September, the wing-feathers developing with juvenile plumage as in the black guillemot. Contrary to all other Atlantic auks the puffin does not develop any first winter dress, corresponding with the fact that the moult into winter dress of the adults is more or less suppressed. The wings of the immature birds are slightly smaller than those of the adults, as might be expected. Bill growth in juveniles: depth of bill at base in August—16, 18, 18, 18 mm.; October to December—17·5, 18, 18, 19, 20, 20 mm.; February–March—20, 21 mm.; April—27, 30 mm.; June—28 mm. So growth is slow in winter, but during the April moult the bill is augmented, and at the same time the facial appendages develop. Spring moult takes place in April: of two juveniles 8th April, one was in juvenile dress and no moult, the other had summer feathers on head and upper parts. The autumn moult of these yearling birds takes place in the summer, that is, much earlier than the adult. A specimen on 7th August of its second summer had already a few winter feathers on flanks and sides of breast. Witherby mentions a specimen in July which was commencing to moult to second winter dress. Probably the younger birds always have a complete autumn moult. In its second summer (that is when it is about a year old) the young bird has a bill smaller than that of the adult and with only one furrow. (With acknowledgments to F. Salomonsen, *The Atlantic Alcidae.*)

APPENDIX VII

SELECTED BIBLIOGRAPHY

ARMSTRONG, E. A. (1940). Birds of the Grey Wind. Oxford and London.

ATKINSON, R. (1949). Island Going. London.

BURCKHARDT, D. (1944). Orn. Beobachter, 5: 49–76.

BUXTON, J., and LOCKLEY, R. M. (1950). Island of Skomer. London.

CONDER, P. J. (1950). Courtship and Display of Three Species of Auks. British Birds, 43:. 65–9.

DARLING, F. (1947). Natural History in the Highlands and Islands. London.

DOBSON, R. (1952). Birds of the Channel Islands. London.

D'URBAN, W. S. M., and MATHEW, M. A. (1892). Birds of Devon. London.

FISHER, J. (1952). The Fulmar. London.

HOWARD, H. E. (1929). An Introduction to the Study of Bird Behaviour. Cambridge.

JACOBSEN, J. F. (1936). Faeroerne Natur og Folk. Torshavn.

KEARTON, R. and C. (1898). With Nature and a Camera. London.

LACK, D. (1943). The Life of the Robin. London.

LOCKLEY, R. M. (1934). The Breeding Habits of the Puffin. British Birds, 27: 214–23.

LOCKLEY, R. M. (1934) in The Countryman, 10: 111–15.

LOCKLEY, R. M. (1938). I Know an Island. London.

LOCKLEY, R. M. (1942). Shearwaters. London.

LORENZ, K. (1952). King Solomon's Ring. London.

MARTIN, M. (1698). A Late Voyage to St Kilda. London.

MATHEW, M. A. (1894). Birds of Pembrokeshire. London.

PERRY, R. (1940). Lundy: Isle of Puffins. London.

RANKIN, M. N., and DUFFEY, E. A. G. (1948). A Study of the Bird Life of the North Atlantic. British Birds Special Supplement, vol. 41.

RAVEN, C. E. (1942). John Ray, Naturalist. Cambridge.

RICHDALE, L. E. (1950). The Pre-egg Stage in the Albatross Family. Biol. Mon. 3. Dunedin, New Zealand.

ROTHSCHILD, M., and CLAY, T. (1952). Fleas, Flukes, and Cuckoos. London.

ROWAN, M. K. (1952). The Greater Shearwater at its Breeding-grounds. Ibis, 94: 97–121.

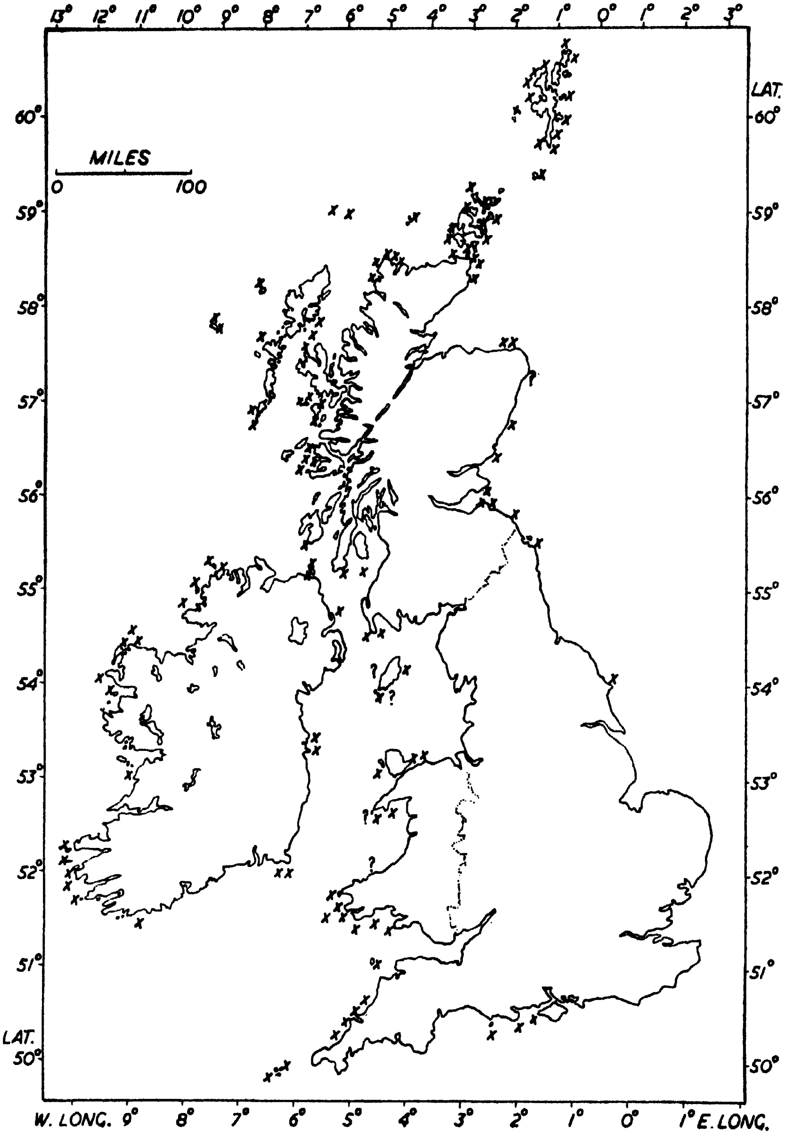
SALOMONSEN (1944). The Atlantic Alcidae. K. Vet. O. Vitterh. Samh. Handl. F. 6. Ser. B. Bd. 3. N:O. 5.

SCHAANING, H. T. L. (1940). Saertrykk av Stavanger Museums 50. Norway.

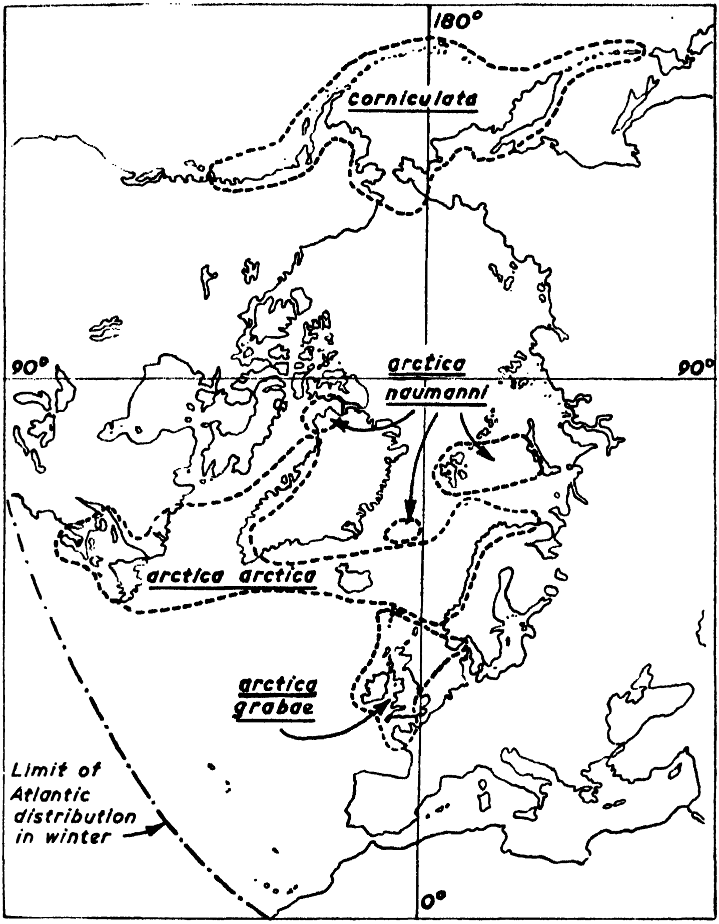
SELOUS, E. (1905). The Bird-watcher in the Shetlands. London.

WILLIAMSON, K. (1948). The Atlantic Islands. London.

WITHERBY *et al.* (1941). The Handbook of British Birds, vol. 5. London.



Breeding distribution of the puffin in the British Isles (1952)



World distribution of *Fratercula* puffins: the Pacific *corniculata*, the arctic *arctica naumanni*, the north Atlantic *a. arctica*, and the European *a. grabae.*

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